

# Aviation Week

*Including Space Technology*

**USAF Pushes  
Minuteman  
Silo Test Shots**

Atlas-Able IV







**REQUIRED:** A lightweight, low-loss, radiation-free cable with electrical uniformity for interconnecting the navigation and communication antenna circuits of the Douglas Aircraft Co.'s new DC-8 jet airliner.

## SPECIFIED: *Foamflex® Coaxial Cable*



A semi-flexible cable with tubular copper inner conductor, foamed polyethylene dielectric and commercially pure aluminum outer conductor.

With outstanding advantages for use in aircraft navigation, communication and warning circuits that include:

1. Twice the efficiency of solid dielectric (RG-8<sup>1/2</sup>) type of cable now in general use.
2. Extended life characteristics that permit permanent installation and assure electrical stability during the life of the plane.
3. Good frequency response over wide temperature variations; capable of withstanding highest summer ground temperatures, as well as extremely low temperatures found at high altitudes.
4. Greater efficiency and improved system performance without the use of additional electronic components.
5. Ability to operate in both pressurized and non-pressurized parts of a plane without the use of cable dehydrators or pressurizing systems.
6. Lighter and smaller than many cables now installed in aircraft.

Foamflex coaxial cable is supplied in long lengths on lightweight, disposable reels. For further information or inquiries, write Dept. PC.



**PHELPS DODGE COPPER PRODUCTS CORPORATION**

300 PARK AVENUE, NEW YORK 22, N.Y.

### AVIATION CALENDAR

- Dec. 10**—Vernon Vinton Contact School, Springfield, Mo.; Bruce Hand, Wadington, D. C. Sponsor: Aeronautical Training School.
- Dec. 11**—Ted Wright Southern Eastern National Union Bldg., Northeastern Institute, Washington, D. C. De Alexander H. H. (has died) Air Force Institute will speak on "High Temperature in Hyper-sonic Flow—Physical Principles and Experimental Techniques." Dr. H. H. will report his lecture on Dec. 13 before the 14th Cleveland Section on Dec. 21 before the 15th Los Angeles Section and Dec. 22 before the 16th New York Section.
- Dec. 26**—16th South Korea Design International Visual Film, Viet Nam, the Dec. 26th—Visual Meeting American Air for the Advancement of Science, National Hotel, Chicago, Ill.
- Jan. 12**—13th South National Symposium on Reliability and Quality Control at Elvins, Skidder House Hotel, Washington, D. C.
- Jan. 13**—14th Annual Technical Conference of Society of Physics Engineers, General Union Hotel, Chicago, Ill.
- Jan. 15**—15th Annual Visual Meeting American Technological Meeting, Hotel Hilton, New York, N. Y.
- Jan. 21**—16th Annual Conference of the Aeronautical Sciences Institute, Hotel New York, N. Y. Honor Night, Dec. 21, Jan. 26.
- Jan. 28**—17th Annual Proceedings Conference, American Rocket Society, Princeton University, Princeton, N. J.
- Feb. 1**—18th Annual Conference of Physics Engineers, Hotel New York, N. Y. Honor Night, Dec. 21, Jan. 26.
- Feb. 3**—19th Annual Meeting, Chicago, Ill. Sponsor: American Research Foundation of Illinois Institute of Technology (Continued on page 6)

### AVIATION WEEK including Space Technology

**December 7, 1959**  
Vol. 71, No. 22

Aviation Week includes a combined issue on Space Technology and a combined issue on Space Technology and Space Technology. The combined issue on Space Technology and Space Technology is published by the American Institute of Aeronautics and Astronautics, Inc., 1801 Alexander Bell Drive, Garden City, N. Y. 11530. The combined issue on Space Technology and Space Technology is published by the American Institute of Aeronautics and Astronautics, Inc., 1801 Alexander Bell Drive, Garden City, N. Y. 11530. The combined issue on Space Technology and Space Technology is published by the American Institute of Aeronautics and Astronautics, Inc., 1801 Alexander Bell Drive, Garden City, N. Y. 11530.

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# Eastern

TEMPERATURE CONTROL EXPERIENCE:

## AVIONIC COOLING



Eastern cooling packs for electronic equipment extend operating ranges to altitudes where air cooling becomes ineffective. Block heat designs can be same compact—efficient even as five times the speed of wind.

These liquid cooling systems are completely self-contained—provide such components as pumps, heat exchangers, no expansion, non-toxic, coolant flow and temperature interlocks and sensor parts.

Cooling capacities of existing systems range from 1,000 to 50,000 watts dissipation rates. Eastern cooling packs take ambient temperatures from -55°C to +55°C in cruise, and perform to altitudes of 60,000 ft.

Eastern's experience in missile applications has enabled Eastern to develop systems normally engaged and light at well as highly reliable. At the same time, Eastern is able to provide at maximum cost equipment engineered in a specific need by using metal-processed components designed to your system configuration.

Turn to Eastern for specific weight, and cost-orient solutions in your hottest cooling problem. Write for New Bulletin 560.



Liquid cooling units for 50 to 50,000 watts dissipation

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## Here is a man you should know he's a **DELAVAN FUEL INJECTOR SPECIALIST**

James D. Brecker specializes in injection devices using flow controls. He's a Senior Project Engineer with Delavan. And during his six years of developmental experience, his products have become initial material choices as some of the world's most advanced jet engines for aircraft and missiles.

It's specialized engineering talent like Jim Brecker's that has made Delavan first choice for fuel injection problem solving. If first engineering and innovation are part of your product, take advantage of Delavan's specialized experience and proven ability to deliver aircraft quality. Send specifications to the address below for obligation-free recommendations.



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*Manufacturing Company*

MADE IN LARGEST MANUFACTURE OF NEEDLES • WEST COAST WORKS • BINA

## AVIATION CALENDAR

(Continued from page 7)

of Technology, Chicago Section, American Welding Society

Feb. 3-5-1960 Winter Convention on Solid State Electronics, Institute of Radio Engineers, Belmont Hotel, Los Angeles

Feb. 10-12-Seventh Annual Solid State, Circuit Conference, Philadelphia, Pa. Sponsored by Institute of Radio Engineers, Western Institute of Electrical Engineers, University of Pennsylvania

Feb. 16-18-41st National Symposium on Nondestructive Testing of Aircraft and Missiles, Composites, Hilton Hotel, San Antonio. Tex. Sponsored by American Society for Nondestructive Testing, Southwest Research Institute

Mar. 18-21-National Flight Propulsion Meeting (classified), Institute of the Aeronautical Sciences, Cleveland, Ohio

Mar. 23-25-Symposium on Optical Spectroscopic Measurement of High Temperature, University of Chicago, Chicago

Mar. 27-29-Symposium on Space Vehicle Science Laboratory, Jet Propulsion Co., National Science Foundation

Apr. 6-8-Structural Design of Space Vehicles Conference, Bellman Hotel, Santa Barbara, Calif. Sponsored by American Society of Structures and Materials Committee

Apr. 6-8-1960 National Meeting "Thermal Environment-Space Frontier", Institute of Astronautical Sciences, Belmont Hotel, Los Angeles, Calif.

Apr. 19-21-International Symposium on Atomic Materials and Fuel Reactors, Engineering Research Bldg., New York, N. Y. Sponsored by Institute of Radio Engineers, Department of Defense Research Agency, Institute of Radio Engineers

Apr. 23-25-National Symposium on Advanced Space Systems, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif. Cosponsored by National Aeronautics and Space Administration, the Royal Corp.

Apr. 23-25-3rd Annual Methods & Materials Conference "Metals and Materials for Space Age", American Institute of Aeronautics, Anaheim Hotel, Los Angeles

Apr. 23-25-41st Annual Convention and Exposition, American Welding Society, Belmont Hotel and Crow's Western Exhibit Center, Los Angeles, Calif.

Apr. 27-28-National Meeting on Space Age Materials, Convention Chapter of the American Society for Metals, Sheraton Gateway Hotel, Cincinnati, Ohio

May 9-11-1960 Symposium of the American Society of Radio Engineers, Professional Group on Microwave Theory and Technology, Hotel del Coronado, San Diego, Calif.

May 9-11-Second Southwestern Metal Congress and Exposition, American Society for Metals, Sheraton Dallas Hotel and State Fair Park, Dallas, Tex.

May 16-18-1960 Electronic Components Conference, Willard Hotel, Washington, D. C. Sponsored by Institute of Radio Engineers, Professional Group on Component Parts, American Institute of Electrical Engineers, Baltimore, Indiana, Van, Western Electronic Manufacturers Assn.

## NOW! A Complete New **MARMAN** Catalog of Aircraft/Missile Tube Joint Products

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CONOSEAL TUBE JOINT



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V-BAND COUPLINGS

Here's complete design information for aircraft and missile segments working with tubing and steel joints. The new 40-page Marmar Catalog No. 800 contains helpful design data plus full product information on these Marmar products.

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AB-12



How to remotely synchronize valves in a temperature range of  $-100^{\circ}$  to  $1200^{\circ}$ . Or...

...how to reduce weight of a remote control system by 54%-40%, space by 90%. Or, run controls in pressurized areas without affecting operations. Or, get greater response over possible failure with a system that is 92% efficient on 90° bend.

The "how" is with TELEFLEX® — the "why" is the exclusive TELEFLEX cable design. No remote control cable anywhere gives such high sensitivity and response... such a reduction in weight and bulkiness... such design freedom with straight line, angular and unlimited rotary motion!

The technical advances made possible with TELEFLEX cable were due to TELEFLEX engineers' basic good faith and can also serve as the development of complete mechanical control systems for any purpose. Write today... for catalog, or help on your specific problem! TELEFLEX Incorporated, North Wales, Pennsylvania.

TELEFLEX SYSTEMS offer unmatched design flexibility because they are the only systems to offer all three types of mechanical motion...



**TELEFLEX®**  
INCORPORATED

**Where so much  
DEPENDS ON SO LITTLE...**



On turbines... in compressors... in hydraulic units... and in a host of other vital locations — the bearings must deliver at critical moments.

A high proportion of them are solid cylindrical roller bearings... very simply because they do a better job over a longer period in less space.

Just how a Rollway Air-Rol Bearing will fit in critical applications is explained in the new Air-Rol Data Book. It contains new and vital criteria for bearing selection. A letter or company stationery will bring it to any qualified person by return mail. Rollway Bearing Company, Syracuse, N. Y.

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**HIGH CAPACITY**—With an 8-ton payload, Sikorsky's new S-64 turbine-powered crane will carry more than twice the experimental S-60. It is the first in a new family of Sikorsky turboprops designed to carry up to 10 tons.

**TOP VERSATILITY**—In restricted areas where even a helicopter cannot land, the S-64 is designed to raise and lower loads on a hoist, as above. Where landings are possible, cargo can be attached by cable to four hoist points on the fuselage. The S-64 is designed to straddle bulky loads nine feet high and almost 20 feet wide. A variety of passenger and cargo pods, bins and platforms, plus almost vibration-free suspension will make the S-64 a Universal Transport Vehicle of unprecedented versatility and usefulness for military or commercial service.

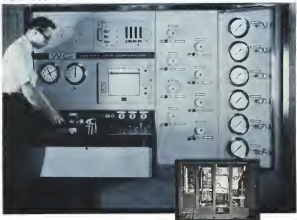
**PROVED DEPENDABILITY**—Sikorsky's program of step-by-step progression with thoroughly proved designs and components will ensure users almost dependability. Vital engine assemblies, gearbox, controls, and other dynamic components for the S-64 have been proved by years of service in Marine Corps and Army S-55-type helicopters. The engine concept has been tested and demonstrated for many months in the S-60.

**FIRST FLIGHT**—The first S-64 is programmed for flight in the fall of 1960.

**SIKORSKY AIRCRAFT**, Stratford, Connecticut  
A division of United Aircraft Corporation

**Sikorsky S-64**  
—new 8-ton  
payload  
turbine-powered  
flying crane

Three system test stand console designed by Western Gear for full servicing of General F-100 Turbo-Drive unit. Fourteen individual performance tests guarantee reliability. High pressure hydraulic test at 1500 psi, low pressure at 200 psi, pneumatic emergency test at 800 psi. Features include safety provisions to prevent test damage during test and malfunctions. Performs static, operational, load, stall and recovery tests, includes: recovery and recovery. Stainless steel piping throughout.



This craftsmanship shown in this sturdy yet simplified design of a complete test stand, designed, developed and built by Western Gear.

*Reliability is assured...*

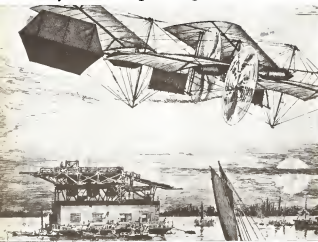
#### WITH GSE EQUIPMENT BY WESTERN GEAR!

The Achilles Heel of all aviation equipment is reliability. At Western Gear, we have identified our product contributions with the slogan, "The Difference is Reliability." Western Gear produces test stands and consoles that are designed with capabilities to quickly and efficiently check out wide varieties of both airborne and ground equipment. The console illustrated is indicative of Western Gear design and productivity; it was specifically designed to completely, quickly and accurately check out the Turbo-Drive used on the Conquest F-100. In this instance, the drive is also our product. No matter what your test requirements may be, Western Gear can make an outstanding contribution to the effective solution of your problem. Write, wire or telephone now to

**WG** WESTERN GEAR CORPORATION "The difference is reliability"

**WESTERN GEAR CORPORATION** • PRECISION PRODUCTS DIVISION • P.O. BOX 102 • DENV003, COLO. • Model 4-460

## Propulsion through the ages...



*Following "seaboard" design of Prof. Samuel P. Langley, 1903*

An outstanding proposal—in 1903, dawn of the air age, Professor Samuel P. Langley, then Secretary of the Smithsonian Institution, drafted the first tripropeller aircraft, and with good reason. Models of his "aerobee" had successfully flown over the Potomac. Langley was the first of the pioneers with lightweight power at his disposal—a 34 hp. engine turned two pusher propellers. Two aircraft were made to fly the full-scale machine from the sand and houseboat, in October and again in December 8, 1903. Each time it plunged into the river. An official report cited the launching mishap as one of the

failures. Nine days later the Wright brothers flew. Today, near the banks of the Potomac, Rotol, the world's most experienced manufacturer of turbo-propellers, stands as America's subsidiary, Rotol Incorporated, for after sales service on turbo-propellers in North and Central American and Caribbean service. Over 100 engine and aircraft operators throughout the world attest to the reliability of Rotol turbo-propellers, standard equipment on the Vickers Viscount, Fairchild F-27, Cessna 441, Gulfstream, and many others.

# ROTOR

The world's most experienced manufacturers of turbo-propellers—over 6,000,000 hours of flying time.

Rotol Incorporated after-sales service throughout the United States provides immediate spare parts delivery, technical advice on propeller operation and application.

For information on Rotol products and after-sales service call Rotol Incorporated, 409 Jefferson Davis Highway, Arlington 2, Virginia. Phone OT 4-6299.



This is an actual photograph of 1 1/2" Springfield "400" hose.

**NOW!**  
design with  
large diameter  
**Teflon® hose**  
that  
**bends like this!**

If you design fluid handling, transfer, or hydraulic equipment, you already know Teflon hose. Wonderful! Except, up to this time larger diameters were not really flexible. But now look!

**SPRINGFIELD "400"™ WITH FINGER FLEXIBILITY ONLY TITELFLEX HAS IT!**

- Minimum bend radius: only 2 1/2 times the hose diameter! Thanks to the exclusive TITELFLEX process.
- Teflon unexcelled with all its properties. It's tough, lightweight, inert, resistant to corrosion and temperature extremes. Flex life is almost endless.
- Available now up to 5" in diameter, lengths to 25 feet (soon to 50').
- Fittings prove failure-proof—right up to burst pressures of 500'.
- In many cases, a shorter Springfield "400" hose can replace extended hose at big savings.

Springfield "400" has already made exciting news in scores of applications—new uses crop up every day. How about your field? Our bulletin will set design ideas chinking. Get a copy by dropping us a line direct.

**titeFlex**

**T**

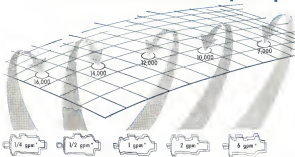
**Do these Springfield "400" applications suggest anything to you?**

HAUL, TAIL, BARGE, MILITARY VEHICLE  
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PLASTIC CONCRETE • HOT TAR AND ASPHALT •  
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High temperature fuel and lubrication systems •  
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and special support •

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\*Teflon is a duPont trademark  
†1 1/2" is outside dia., 1 1/4" inside

# a new look at HIGH SPEED CAPABILITY in STRATOPOWER pumps



\* Based on 1000 psi. These are what we've been calling "high speed" pumps. But even "regular" models far surpass accepted speed standards.

## We used to distinguish "high speed" and "regular", BUT...

With STRATOPOWER "high speed" denotes not a specific group of models but a characteristic. No departure from basic design has been made to achieve high speed capability—STRATOPOWER engineers have simply "let out" the speed forcing forces inherent in a thoroughly tried and proved design. The experience gained with "high speed" pumps has readily been fed back into "regular" models.

## Now the Barriers are Down!

STRATOPOWER can provide "regular" 6 gpm pumps for limited life applications demanding 7,500 rpm and stand reliability — 50 highly satisfactory horsepower in a 16-lb. package! This and other new possibilities indicate that the old speed standards have been abolished.

You will be amazed at the speed ranges now available in an extensive selection of STRATOPOWER models. Before discussing any hydraulic application possibility on the basis of customer speed requirement, check with your STRATOPOWER representative. He will be happy to discuss models and speeds in combinations you never before considered. It is possible that, in your specific application, even the speed shown above can be exceeded considerably.

Well qualified engineers in hydraulic and control design are invited to investigate their potential as a member of the STRATOPOWER organization. Please contact W. G. Watkins, Personnel Manager.

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## A unique approach to problems of AUTOMATIC CHECKOUT and MONITORING



**MSI**—Monitor Systems Incorporated—is an autonomous subsidiary of Epson, Incorporated... leader in the field of data control and a pioneer in the development and manufacture of automatic checkout and monitoring equipment. MSI offers unmatched talent of the highest caliber, backed by Epson's long experience in this highly specialized field.

To these advantages is added another important asset... concentration.

MSI is an independent company with its own, entirely separate staff and facilities; it is not a department of a large organization competing for operational resources with other departments. As a result, all the research, design and productive effort are concentrated upon a single objective... the advancement of automatic checkout and monitoring systems technology for weapon systems and sub-systems testing, aircraft pre-flight testing, reactor engine monitoring, process monitoring, component testing.

Current projects at MSI amply demonstrate the specific and tangible advantages that result from this unique set-up.

We are completely staffed at all engineering levels—ready to **FULLY** your automatic checkout and monitoring needs. Guidelines are limited in regard to your requirements.

**MONITOR SYSTEMS INCORPORATED**  
Fort Washington, Pennsylvania

A subsidiary of **Epson** Incorporated



## GPL systems management

equipment for the Federal Aviation Agency

GPL's subsidiary for the FAA's experimental data processing center—the heart of tomorrow's air-traffic control system—point up the diverse talents required of an effective systems manager.

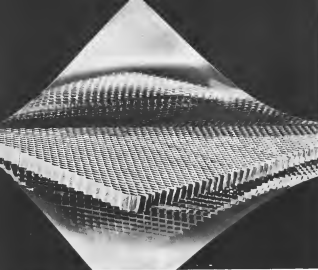
As prime contractor for the FAA Bureau of Research and Development project, GPL contributes to the design and assumes responsibility for direction, schedules, plans, budgets, and the performance of this associated company. Necessary technical capabilities include broad knowledge of air-traffic control problems, computers, data handling, radar, communications, human engineering, and "systems thinking" capable of integrating these varied disciplines into a practical, workable system.

The FAA data processing center is but one of a number of current airborne and ground-based programs reflecting GPL's capabilities as systems manager. Supporting these programs are a "systems" oriented technical organization, a "customer" oriented management, and a complete capability from research, engineering, and manufacturing on through to customer service.

The systems management skills of GPL are available to you. Write for further details on the application of these skills to your problem.

GPL Airline Division/airline computers/vehicle positions/  
in-flight/ground computers/data loading systems/  
communications equipment/airline maintenance control TC

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December 7, 1959

# Aviation Week

Including Space Technology

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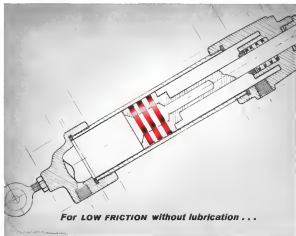
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## EDITORIAL

### A Dangerous Decision

The decision to cut the B-70 Mach 3 bomber development program to a bare skeleton (see p. 36) is one of the most dangerous decisions made in this country during the past decade. It is comparable in character and magnitude of error to the historic post-war British decision to abandon the pursuit of supersonic flight with manned research vehicles—a blow from which British aviation has not yet recovered.

The B-70 development program represents considerably more than any possible economic effect on North American Aviation, Inc., the prime contractor, or its myriad of subsystem developers and subcontractors scattered throughout the country.

In its essence, the B-70 program is the spearhead of the research effort whose goal is the development of the next significant generation of aircraft—both military and civil—which happens to be in the Mach 3 area. It also represents the effort to preserve a basic vital element in our future aerial war, whether fought with missiles, manned vehicles or both.

This is the ability to penetrate any enemy's territory and return safely. Without this ability even the strongest missile capability is subjected to severe limitations in its potential effectiveness. The ability to penetrate successfully and return is necessary even for the effective use of ICBMs because they are fairly blind without accurate prelaunch reconnaissance information to precisely locate fixed enemy targets, to provide the latest data on moveable enemy targets and to provide post-submission on damage results and to attack surviving targets. It is also necessary because there still always be significant military targets that are either too mobile for an ICBM attack or too well concealed. For these targets, an aerial vehicle will always be necessary to locate, attack and destroy.

### Skepticism Justified

It is true that the B-70 decision, which was bitterly opposed by the Air Force and resented on it by a strong White House-Berger Bureau chief, does leave the shell of a Mach 3 aircraft research program remaining. However, in view of the preliminary whittling during this year on what was once a major program, certain skepticism appears justified in assuming that the whittling will not stop there with the Fiscal 1963 budget decision and that even the remaining program will have difficulty in surviving another round of "economy" budgets. Next year it will be even easier to justify the final slash because of what little remains after the current chopping and its shift from a weapons system to a research program.

The basic effect of the B-70 budget slash decision is to artificially create a tremendous technical gap in our strategic deterrent force by doubling Strategic Air Command to rely primarily on its subsonic Boeing B-47 and B-52 bomber fleet until a significant Minuteman and Polaris missile force is equipped some five to seven years hence. And even then it will have the same basic flaw without sufficient reconnaissance or follow-up strike

capability to be truly effective as a strategic deterrent.

It may be difficult for military men trained by an organization that is still using the Browning automatic rifle designed in 1890 and a standard service patrol used against the Moros by the then Cape John Penning before the dawn of the 20th century, to fully comprehend the speed, scope and significance of the impact of modern technology on military weapon development. With this type of background it is not surprising that they are not disturbed by the vanishing technical gap they are creating and still clutch against a "reconnaissance hysteria" tag about the business of getting something new.

### Financial Winger

Some people have suggested that this gap will be adequately filled by the Mach 2 Convair B-58 bomber. The B-58 is a fast weapon and a significant step forward in improving the military capability of Strategic Air Command. Until recently it has been pushed to the limit of its manufacturer's technical capability. It is still the only such aircraft created in the world today. But the B-58 has been put through much the same financial winger that is now squeezing the vitality from the B-70 program. Consequently, unless the course of these decisions is also reversed, the B-58 will enter the SAC inventory in too small quantities, too late to ever realize its genuine military potential.

On the civil side, the curtailment of Mach 3 aircraft development will hand to the Soviet Union another opportunity to strike a tremendous blow at this country's technical prestige and our air superiority, which today is unquestionably the first in the world. The development of a supersonic transport will be the key to the next generation of international air transport. All current evidence points to the Mach 3 range as the most promising area for this effort.

As anybody in the aviation business knows, the development of an aerodynamic research vehicle to fly at Mach 3 and the cancellation of development on all of the vital adaptations required to make it function as a useful civil or military vehicle will make little genuine progress toward any significant goal. In fact, when the B-70 program is cut in 1963 without these vital adaptations its achievement will be as hollow as its empty airframe. This will, of course, give its critics even more grounds to abolish the program because it obviously has not produced a truly useful vehicle.

This is the process of short-sighted and technical cautions by which we are losing the lifeblood of our technical ability spill out onto the barren ground of false economy. This is how we are losing the dynamics of our technical pace.

The B-70 stretchout decision is supposed to save \$85 million in Fiscal 1963. This may be true but the ultimate price of this economy may be our existence as a free and independent nation.

—Robert Hottel

## In the Front Office

Carter L. Rogers, a director of American Airlines, Inc. Mr. Rogers is president of American Airlines and formerly Co. American also elected Douglas D. Taylor a vice president, he will continue in charge of the company's Washington office.

C. R. Able, vice president-defense programs, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Dr. Coleman J. Dell, Bendix, president and a director, Aeronautical Research Association of Princeton, Inc., Princeton, N. J. Also Roger D. Sullivan, assistant president and a vice president and a director, Bell and a vice president, Bell Telephone Laboratories, Inc., New York, N. Y. Scott, a director, M. J. Scott is assistant professor in the Department of Aeronautical Engineering at Princeton University.

James D. Lark, vice president for Irish Air Lines in North America, succeeding Michael J. Duggan who is returning to Dublin to resume the position of assistant general manager.

W. R. Gray, a division vice president and engineering department manager, Bendix, a division of Northrup Corp.

Walter J. Enck, executive vice president, Hoffman Electronics Division of The Sperry Corp., Ann Arbor, Mich.

Richard A. Campbell, vice president operations, Pacific Seacore, Inc., Culver City, Calif., a subsidiary of Thompson Radio Works, Inc.

Healey L. Schum, assistant director, Air Transport Traffic Control, Air Transport Asia, Washington, D. C.

Rear Adm. Leonard D. Coates, Jr., recently Deputy and Assistant Chief, Bureau of Aeronautics, assigned to the Office of the Chief of Naval Operations.

Clifford P. Benton, Chief of the Analysis Division, Office of Plans and Requirements, Federal Aviation Agency, Washington.

## Honors and Elections

Dr. Howard S. Rosen, special assistant for professional development at Space Technology Laboratories, has been elected president of the American Rocket Society.

Dr. Harold W. Rittap, vice president and technical director of the Rocket Division of Thiokol Chemical Corp., has succeeded Dr. Stefan as vice president of the Society.

James S. McDowell, Jr., president of McDonnell Aircraft Corp., has been elected chairman of the board of governors of the Aerospace Industries Assn., succeeding C. J. McCarthy, chairman of Chance Vought Aircraft, Inc.

Joseph E. Cushman has been elected president of the National Aeronautics Assn., succeeding Thomas G. Langley, Jr., a vice president of Convair, who was elected chairman.

Marlin Davis, president of Decker Corp., was elected first vice president.

Robert F. Whiting, vice president engineering, machine and space systems for Douglas Aircraft Co., has been elected chairman of the newly organized Guided Missile Council, Aerospace Industries Assn.

(Continued on page 172)



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## INDUSTRY OBSERVER

►Projections for test stands to accommodate 28 million-thrust power plants are being analyzed for location at Edwards AFB, Calif. Big problem would be ability to conduct acoustic phenomena. Reworking a new design concept, test stands would serve Air Research and Development Command and National Aeronautics and Space Administration projects.

►Bochtel Corp. is performing a study for Air Force Ballistic Missile Division under the Minuteman solid-propellant ballistic missile program to determine how best to assure power requirements for remote missile operational capability if all other power sources to a base should fail.

►Third Ballistic Missile Early Warning System (BMEWS) installation will be made at Ft. Meade, Md. in East Yonkers, Tagford, instead of in Scotland as earlier planned. New BMEWS installation is expected to have long range surveillance radar systems similar to systems installed near Thule, Greenland, aimed so as to detect missiles launched from southern portions of Soviet Union or its satellites as well as missiles fired over polar region from northern sites.

►Planning is under way to establish a specific timetable for transfer of responsibility for executive management of the Atlas ICBM from the Ballistic Missile Division to the Strategic Air Command for operational status and the Ballistic Missile Center for logistic support. Specific pretests for transfer of Atlas are scheduled to follow within the next interim. There will be followed shortly by a timetable to switch the management responsibility for Minuteman, still in its early research and development stage.

►Japan may order a total of 20-30 F-104Ds from Lockheed Aircraft Corp. if the Lockheed agency is officially chosen for the Japan Air Self Defense Force. Aircraft would be used for training before the F-104CJ begins coming off the production line in Japan. Japanese probably would produce about 200 of the Lockheed fighter under license, and approximately 100 would be the two-seat F-104CJ version. F-104CJ has the same general weight, dimensions and performance as the basic F-104C, although some different avionics equipment will be used.

►Sensis, advanced television reconnaissance subsidiary of the WS-847L program, is being searched for logistics and support literature requirements relating to the size; the system is expected to be phased into operational status with the Strategic Air Command.

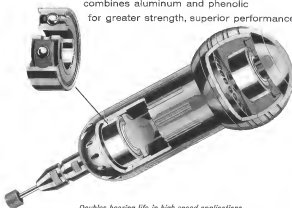
►In Sefar bomb development progress related to the Atlas, Titan, Thor and Minuteman, some more research techniques, Resolute Powder Co.'s Detonator Research & Development Co. division is working on cutting down bomb weight by reduction of base weight and the substitution of aluminum for steel parts. Another refinancing in development of a time fuse is a substitute for the hydrostatic type. Companies also is working on stage separation devices for Minuteman and Thor, projects and design activities for Atlas systems.

►Martin is procuring research and development ground equipment costing about \$250 million for use in connection with captive track and launchings of the Titan ICBM.

►Automated repair parts provisioning unit which could be applied to weapon systems such as the Polaris fleet ballistic missile and the succeeding generation ballistic missiles has been developed by Planning Research Corp. for the Naval Ordnance Supply Office.

►Lockheed Aircraft Corp., Burbank, is studying future ballistic missile mobility possibilities concerning transportation by rail, truck and water. Letter study includes large LST-type barges with provisions to be sunk and anchored in shallow-water bottom for the section of the missile to vertical. Then refloat barge after firing. Studies are company-funded.

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for greater strength, superior performance



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## Washington Roundup

### New ASW Command

Watch for a Navy announcement within the next future of plans to establish an integrated anti-submarine warfare force on the Pacific along the lines of the Atlantic Fleet's Anti-Submarine Defense Force, which has long in existence for the past few years. Commander of the new Pacific force being organized in an effort to tighten defenses against Soviet missile submarines will be Rear Adm. John S. Thach, who has commanded Task Force ALFA since it was organized only last year to carry out extensive maneuvers to help determine Navy's equipment needs in this field and to improve ASW operational techniques. Thach, who will pass the mark of vice admiral with the number, is expected to move into his new post early next year.

In a related move, the Navy announced last week that Rear Adm. Edmund H. Taylor, vice commander of the Atlantic Fleet destroyer force, will succeed Vice Adm. William G. Cooper as commander of the Atlantic Fleet's Anti-Submarine Defense Force. Taylor also will be promoted to the rank of vice admiral.

Navy also named Vice Adm. William R. Smith III to the post of deputy chief of naval operations for personnel, replacing Vice Adm. Harold P. Smith. No new assignments were announced for either Cooper or Smith, but Smith has been mentioned previously in the past as a possible successor to Adm. Joseph Wright as commander of the Atlantic Fleet and NATO as France opens the latter's retirement next year.

### Patent Policy Review

Controversial National Aeronautics and Space Administration patent policy may eventually inspire a complete overhaul of national patent policy. Unlike other federal agencies, NASA is legally required to take title to all inventions made under its contracts and this situation has prompted the National Council of Patent Law Attorneys to launch a strong attack of all existing and proposed U. S. patent regulations. Review will be made to help Congress frame legislation to establish a uniform national patent policy for all federal agencies.

### Apples and Oranges

Richard E. Horner, associate administrator of the National Aeronautics and Space Administration, was asked on a television news program last week why the U. S. did not follow the Russian plan of using "models in depth" and more than one of the same type of vehicle to look up specific space orbits. Horner replied:

"I think we have generally looked our program around a concept of a broader scope of different kinds of endeavors than the Russians have and relied on a backup in the sense of a flexibility in switching from one endeavor to another, rather than to use our resources all in one specific endeavor."

Asked a moment later, "What are some of the different areas where we are preparing projects in which the Russians are not able?" Horner said:

"I find it pretty difficult to answer that question to the extent of what we are doing that the Russians are not doing because we have very little information on what the Russians are doing until they have done it. And of course we are talking more recently about things that we are preparing to do."

### Accident Data Release

Reports by the Civil Aeronautics Board against the Federal Aviation Agency practice of releasing recordings of tower-plot conversations immediately after an accident are not likely to bring about any changes in the policy. FAA officials point out that any broad-based information automatically becomes public information since, once it is on the air, it is available to any listener. For this reason, FAA says the information cannot be intentionally withheld, and, therefore, will be released as a practice that is never applied to other data surrounding an aircraft accident. According to FAA, the CAB has been the sole objector to the policy, and its similar complaints have been answered from its centers.

### Bahamas Guest List

Conferees over attending names of officials entertained by the Martin Co. at the Bahamas Electronic Club in the Bahamas (AW Sept. 21, p. 25) came to a close last week when the House Armed Services Investigating Subcommittee released a guest list of over 15 high-ranking officers, defense Department officials and industry representatives.

George M. Bunker, Martin board chairman, presented a list drawn from his recollection to the subcommittee in executive session in September. Bunker called on the subcommittee, headed by Rep. Edward Robert (D-Cal.), to make the list public. Robert replied that the list was Bunker's, and it was up to him to make it public.

Subcommittee released the list last week after an oral visual check on each of the names supplied by Bunker. The guests included Air Force Secretary James H. Douglas and Gen. Nathan F. Twining, chairman of the Joint Chiefs of Staff. It was specified that Douglas paid his own expenses. Twining was a Martin guest in the Bahamas on three occasions: Mar. 7-10, 1957; Feb. 14-16, 1958; Feb. 26-Mar. 1, 1959.

### Chavez Budget Views

Sen. Dennis Chavez (D-N.M.), chairman of the Senate Appropriations Subcommittee for the Armed Services, is satisfied with an overall figure of \$41 billion for the fiscal 1960 defense budget. The sum is sufficient to make savings, Chavez suggests, it is tightening up on contractors. "Purchasing, and, of course, inspection," he commented last week. The greatest need for improvement in the military establishment, he added, is in housing and hospital facilities.

### Christmas Mail Boost

Christmas mail deliveries will be expedited this year as a result of an agreement between the Post Office Department and 17 airlines. Finding a Civil Aeronautics Board decision on the air transport of non-priority mail (AW Nov. 23, p. 46), the carrier have agreed to transport first-class mail on a space available basis this month at rates of approximately 50% of those currently paid by the Post Office for the carriage of priority mail. The one-month trial, however, is extended only to aid airmail delivery during the holiday season and has no bearing on the final outcome of the air-priority rail case.

—Washington staff



AVIATION WEEK  
ILLUSTRATION BY ROBERT CO.

AVIATION WEEK artist's conception of B-70 carrying a D-19 type vehicle is one of several notions proposed for the aircraft.

## Budget Cuts Force Stretchout of B-70

Major subsystems eliminated, flight date delayed;  
North American will recall airframe subcontracts.

By J. S. Biter, Jr.

Washington—Stretchout of the North American B-70 March 3 heavy bomber program, including the elimination of major subsystems, was announced by the Air Force last week after its appropriations request for the project was reduced by the Administration from \$160 million to \$75 million for Fiscal 1961.

The reduction in funds will cause the rollout of approximately 2,000 North American employees in its Los Angeles Division and has forced the cancellation of contracts for three major B-70 subsystems under development. These are:

- Inertial type bombing/navigation system being built by the Lockheed Research Division of International Business Machines Corp. The stable platform, which is the heart of the system, was subcontracted to the Avionics Division of North American. Approximately \$50 million had been spent on this system thus far.

- Electronic communications system for pattern defense of the aircraft against guided missiles which was under design by the Air Arm Division of Westinghouse Electric Corp. Investment in this system amounts to about \$2.5 million to date.

- Mission and traffic control guidance consisting of communications, navigation and various identification equipment. Western Mifflin Electronics Center at Monrovia, Inc., was the sub-

contractor and approximately \$100,000 had been spent on the system.

A total of approximately \$190 million has been appropriated for the B-70 program through Fiscal 1960 and all but \$25 million of this has been released by the Department of Defense. Even commitment of funds to date has been estimated at between \$149 million and \$130 million, but the Air Force plans to use all of the \$575 million that has been approved and released for the B-70 that far. Appropriation for the project is Fiscal 1960 was approximately \$150 million.

North American has received permission from the Air Force to bring all other major subcontracts back on its own Los Angeles Division as an effort to reduce expenditures. The contracts

affected are with Boeing Airplane Co., which was building the B-70 wing; Compu Division of Lockheed Aircraft Corp. for the upper fuselage, and Chance Vought Aircraft, Inc., for the vertical and horizontal stabilizers. Approximately \$179 million have been spent with Boeing, \$57.5 million with Lockheed and \$4 million with Chance Vought.

It is estimated that a one-year stretchout of the long lead time bombing/navigation, electronic communications and mission control systems would extend the earliest possible operational duty date 1967 to 1967.

Original Air Force plans were to begin the prototype phase with the B-70 and cut several years from its lead time by building production aircraft from the beginning. Under this arrangement, 15 test aircraft would have been built, one for static load testing and the others for flight. Most of this group would have entered operational service after the flight test program was completed.

The present funding situation, however, will make it possible to build only one aircraft; probably to be designated the XB-70. Prototype flying will precede production aircraft in several years. This type of development schedule has been common in the Air Force and was used for the B-47, the B-1 and most other large aircraft. First flight of the production type B-70s had been

planned for 1962 but, under the new plan, the single test aircraft will not fly until 1967.

If a significant number of completely equipped B-70s is to be in operation by late 1970, a decision will have to be made next year by the Administration to accelerate the bombing/navigation, electronic communications and mission control system programs. A number of industry and Air Force officials believe that the Administration's hold-the-line defense spending policy will not be changed for Fiscal 1962 and that there is little chance that any multi-billion dollar bomber production will be authorized until some annual production program begins. They believe that the final agreement between the military and the long-range peacetime aircraft has been decided within Administration circles in favor of the cancel.

### USAF Reaction

Top-level Air Force officials, however, are believed to be in an all-out appeal to Congress and another bid to the Administration for maintenance of the original B-70 program. The Air Force and its allies such as Thiokol Co. of Kansas (Aug. 28), p. 26) are not yet ready to accept the concept that increased force of missiles will ensure aircraft is necessary in any future conflicts. One part of the effort to make the B-70 more attractive economically has been to make extensive studies of the aircraft's maintenance capability.

Under these studies, it has been estimated that the aircraft could serve as a:

- Reconnaissance first stage booster for satellite and Dura-Space-type boost-glider vehicles. The B-70 could drop a 10,000-lb. glider with about 40,000 lb. of upstage booster at 70,000 ft. and at Mach 3 speed. This rocket could reach a 100-mi-high circular orbit. Maximum payload of the B-70 for short range is estimated at 100,000 lb.
- Transporter with about 30 passengers. If the fuselage were widened and lengthened somewhat, the passenger load could be doubled. Such an aircraft probably would be one of the most useful of all aircraft in the Air Force and act as a bonus from the B-70 program. Soviet officials have stated

### V-STOL Fighter

Air Force will buy a new jet fighter—possibly a V-STOL—of which construction will be held to about design freeze early in 1960. Competition for such a contract is expected between Tactical Air Command and USAF Air Staff concerning configuration of fighter aircraft. Funding already has been allocated for Fiscal Year 1960 and 1961 programs, and will be made available when the competition is completed. USAF anticipates it will spend the already approved money in 1960. Design studies are expected from Northrop, Convair, Bell, McDonnell and Republic.

Need for a manned fighter-bomber capable of operating from lower and lower flight up to Mach 2 was pointed out by Dr. Howard A. Wilson, deputy director, research and engineering, Department of Defense, in a speech to the American Ordnance Association in New York last week.

publicly that they have a tremendous transport under development.

- All-weather interceptor for the Air Defense Command. This proposal has been made by the Air Force and the Navy. It would be a 40,000-lb. to 60,000-lb. aircraft for air defense, and it can undoubtedly be shown that it is cheaper to use several smaller fighters than one B-70. However, if the B-70 should be the only Mach 3 aircraft built in the U.S., it may prove advantageous to incorporate some of them into air defense. They could carry a large number of air-to-air missiles, very long range search and fire control radar sets, twice the speed of the B-70, the work of at least three Mach 3 fighters. The B-70 in its SAC configuration is designed to be off the ground as little time as possible after receiving a warning, including simultaneous striking of its targets after a very rapid automatic checkout of its mission orders. This would add to its combat value as a fighter with fast reaction and versatile potential.

Development of the B-70 could give force bonus, air-launched ballistic missiles, air-launched cruise missiles, to manned parasite bombers and reconnaissance aircraft which could be used in the B-70 or directly in a SAC mission. Operation of this wide variety of weapons either has been accomplished in the past by other aircraft or was planned before the B-70 was originally scheduled for first squadron service in 1964 or 65.

A Great size of the B-70 would allow it to be converted to nuclear power once the U.S. develops this type of aircraft powerplant. The crew compartment is about 75 ft. ahead of the cannon air vehicle for its engines which would ease the personnel shielding problem. The

six jet engines are located next to each other so that they all could be supplied with fuel from one central receiver which probably would be located at the rear of the aircraft near the center of 30 ft. of the wing.

Most of the B-70's multi-mission attributes stem from the fact that its thrust-to-weight ratio is very high for a large aircraft. It will weigh something less than 600,000 lb. and have a total of at least 180,000 lb. of thrust in its General Electric J83 engines. The Boeing B-52, by comparison, weighs around 400,000 lb. with 16,000 lb. of available thrust. Its power advantage should enable the B-70 to operate out of B-52 airfields with room to spare and contribute to good performance in all types of flight.

### York's View

A statement last August by Dr. Herbert F. York, Defense Department director of research and engineering, appears to reflect generally the attitude of officials toward missile technology.

After stating that "we simply are not prepared to answer..." whether the unswerving F-108 or the B-70 program would reach the production stage, he said that "some people have 'hanging doubts' about the reliability and accuracy of missiles, but I don't have those doubts much."

Maj Gen John B. Medina, retiring commander of the Army Ordnance Center, Oklahoma, recently said he felt "the manned bomber is necessary on the decline because of the growing

### Life on Venus?

Washington—Feasibility that life can exist on Venus was raised last week after data from a New York high-altitude balloon flight revealed the presence of water vapor in clouds surrounding the planet.

Gen. William R. Kent and astronaut Gus Charles F. Moore of Arthur D. Little, Inc., went to 50,000 ft. in a Navy balloon equipped with a telescope and a spectroscopic device by Dr. John Stew of Johns Hopkins University.

Preliminary inspection of the data revealed indicates that water vapor did definitely exist around Venus, but some definite confirmation will be needed about future temperatures before definite conclusions can be drawn as to the existence of even the most elementary forms of life on the planet.

Scientific opinion is widely divided at present over the range of temperatures on the surface of Venus, with some of the observations made in the last few days indicating a mean of 290C. Other observations have indicated temperatures similar to those on earth.

### Mercure Capsule Order

Washington—National Aeronautics and Space Administration has ordered another six Mercury capsules from McDonnell Aircraft Corp., bringing the total order to 28. Initial deliveries are expected to begin within a month, and will include the first capsule in qualification training, including a launch on the Little Joe booster. McDonnell is building the capsules on a second-year production schedule.



### Lockheed YP3V-1 ASW Electra Vee First Flight

Operational profile of U. S. Navy's Lockheed YP3V-1 antiaircraft patrol plane (AW Feb 23, p. 36) has made its first flight at Burbank, Calif. Tail boom on Electra version houses electronic detection gear and new nose section carries radar equipment. Prototype also carries ASW TSS-18W subsonic developing a top of 18,000 mph at takeoff. Plane can be fitted to carry external ordnance. Company says the YP3V-1 can reach 38,000 ft up, in a single flight at a cost of about one cent per square mile. Cruise speed is about 400 mph. Airline type windows have been replaced with large observer stations.

strength of the air defense is terms of guided missiles, both on one and on two. What the face posed will be I don't know, but certainly it is definitely changing, and I think that that four or five years would be it to a substantial size."

Headquarters Air Force doctrine as it now stands depends heavily upon the B-70 and, if the aircraft fails to reach operational service, this doctrine probably will require a basic overhaul. An Air Force leader believes that air warfare by guided aircraft is still required and that it will continue to be required for the next 10 years at least—the weapons period, for which some operational equipment needs generally are projected.

At any rate, USAF believes, depends upon ability to penetrate all targets, no matter how well they are defended. Penetration is measured in aircraft sent over targets in the only way the Air Force finds it can measure adequate information on damage the enemy has received and on his action during the second phase of any action under new. Manned aircraft also are considered by USAF to be the only weapon that can cause the success of attacks against relatively small targets such as airfields.

An Air Force commander of missile capabilities are that no long-range missile will have the accuracy, or size, of weapons dropped from bombers before 1970. Absolute destruction of targets smaller than large cities will require large numbers of missiles before that time, although the ultimate accuracy of ICBMs is predicted to be good

enough to destroy missiles in hand-to-hand action on a one-for-one basis of 1,000-mph range. Reconnaissance satellites and missiles with automatic equipment will not be accurate or reliable enough to be considered for this vital mission before 1970, according to some Air Force officials.

### Sevier Defense

The doctrine of national protection is now being implemented by a table-top exercise. The exercise, the Russian air defense against this force are being steadily increased, according to intelligence estimates. Air Force plans believe that this doctrine already is being carried to lower the position of missile launchers with current equipment to an unacceptable figure. Steps have been taken to increase the effectiveness of the present inventory of launchers through development of such items as the Hound Dog air-to-air missile, the Green Quest defense missile and more sophisticated electronic countermeasures equipment. An extensive program of SAC with these items is scheduled to begin this year. The maximum production of the Hound Dog is scheduled for 1968.

Continued to some reports the primary purpose of the Hound Dog is not to enable a B-70 to attack a target from distances beyond current defense. The normal station is for each B-52 to attack its prime objective after releasing its three Hound Dogs at other targets on the way. As Newbury says, the objective for Hound Dogs, on the first wave of launchers are the ground-attached missile installations of the

enemy air defense system. It is expected that the bomber force will attack in numbers and fight their way to the main objectives. According to Gen. Kate Partridge, retired commander of the North American Air Defense Command, the concept of defense against an attack by single aircraft or small groups, with maximum penetration being obtained by attacking with closely spaced waves of large groups of aircraft is one air defense strategy.

U. S. plans apparently are to attack in such formations screened by ECM and decoy missiles, while firing large numbers of Hound Dogs at the ground-based defense missiles, radar installations and airfields.

If Soviet air defenses continue to be improved at the present rate, Air Force believes any surface attack will become marginal after 1965, even with the most advanced equipment. Stand-off missiles such as the air-launched ballistic missile or cruise type missiles are not considered to be any more desirable than missiles launched from land or sea if they are not used to mount an attack in penetrating over a target. Manned aircraft, USAF planners say, cannot be justified simply in long-range missile launches.

Anti-Soviet-type weapon systems with extremely high speeds are considered by the Air Force to be at least 10 years away from operational status and that only weapons that have been under serious development during the last three to five years should be counted upon to strike the U. S. defense posture before 1970.

## French Delay Mirage Bomber Decision

Paris—French military budget for 1960 contains authorization for the eventual ordering of 50 Dassault Mirage 4A strategic bombers although final decision on production of the transonic bomber is being held up.

Pierre Gaillardet, French armed forces secretary, revealed this at the end of the National Assembly debate on the 1960 military budget. Mirage 4A, which is a single prototype in development, is powered by two SNECMA Atar 9 turbo-jet engines. It is capable, Gaillardet told Assembly deputies, of carrying the French atomic bomb which he hopes to manufacture.

French trials of the first French strategic bomber, however, still proceed under a cloud. Gaillardet said "the decision to build the production version depends on a new decision of the prime minister's cabinet, and the entire national defense committee."

Earlier in the Mirage 4A debate, Gaillardet defended his department's decision, made several months ago, to stay with the Aérospatiale Mirage 4 instead of moving to the Dassault F3 Mirage (AW Nov. 30, p. 99). Range of action of the Air version, he said, permits it to fly without refueling—something to build missiles as defined by French policy.

Although Gaillardet didn't elaborate on this point, it is generally understood that Air-powered versions of the Mirage would be one-way strategic bombers, landing perhaps in the Near East or southern European targets. Since French officials' decisions suggest that in an atomic war, it isn't worth worrying about returning planes to base.

In addition to the 50 Mirage 4A bombers, the 1960 budget includes authorization for 100 additional Mirage 3 interceptors. This brings to 200 the total number of Mirage 3 authorized by the French Defense Ministry. Other items in the air force budget include authorization for 100 additional F-104 Fregat fighter interceptors and some 573 Mirage fighter interceptors for purchase of 100 surplus Douglas AD-6 Skyraiders and 30 Douglas DC-4 Skyraiders, plus 220 North American F-128 Norwalkers.

By all, the 1960 air force budget totals some \$745 million, of which \$150 million is to be used for research and development projects, new orders and construction. Air force income represents 22% of the 1960 air force budget. Five years ago this percentage was 28%. Over the past five years, air force personnel has dropped some 26%.

Within the overall military budget there is an item for \$44 million which represents new authorization for nuclear

weapon development. Another item authorizes some \$20 million of authorization funds for development work on an intermediate range ballistic missile project "Secretariat or Allied."

Use of American surplus fighter aircraft as ground support fighters in Algeria (see p. 18) has been criticized during the budget debate.

Since 1970, the French air force has made "orders" of surplus North American F-86s with rockets and machine guns for use in ground support operations against Algerian rebels, but now is pushing through a replacement program, including the new F-105.

Deputy Air Chief endorsed the government for trying to make the new aircraft—like the T-6 and the T-28A—the job of combat aircraft. In 1958, 40 pilots were killed and 20 injured in the Alger 15 F-86s. This year, he reported 7-6 pilot losses

as being 25 killed and 11 injured.

In answer, Gaillardet explained that 50% of such losses were due to effective rebel anti-aircraft fire, and not to the "Secretariat or Allied."

Scramble over use of American surplus fighters in Algeria spotlights the aspect of the French aircraft industry over the past five years it has changed and developed greatly, if at least for aircraft specifically designed for the type of warfare the French have been fighting in Indochina and in Algeria. These aircraft began with the F-86 and include such prototypes as the Mirage 3, the Mirage 5, the Mirage 1150, the Sud Aviation's Vahlgard and Dassault's Spide. Each of these aircraft was designed at the impact of French Defense Ministry. But the Ministry has continually shranked the French program to buy American surplus aircraft at cheaper cost.

## U. S. Refuses French IRBM Aid

Paris—French development of an intermediate range ballistic missile is being held up by the refusal of the United States to work with France on a bilateral basis (AW Nov. 2, p. 37).

Informal sources told Aviation Week that American aircraft companies last August were ordered by the U. S. government to cease all cooperation with the French on IRBM studies. The order, these sources claim, has put about brought to halt any French IRBM activity. French officials have admitted it would be impossible for France to develop the IRBM and that U. S. aid would be necessary.

Reason for U. S. unwillingness to cooperate bilaterally with France on an IRBM project is not completely clear. It is generally understood that the U. S. is unwilling to make any arrangement with U. S. technical aid would be given to a group of NATO countries for development of a NATO-controlled IRBM, rather than help France develop an independent weapon which would be controlled only by France.

It was understood that the U. S. decision was jointly agreed to by both Pentagon and State Department officials.

At the time the decision was reached, several U. S. aircraft companies in Europe already were deeply involved in talks with the French atomic study group. This outfit, known as (SIREN) Societe d'Etudes et de Realisation d'Etapes Rotor (AW Aug. 16, p. 28) was set up earlier this year. It is composed of most French aircraft companies plus several government agencies. SIREN's main task is coordinate efforts of French companies in building of an IRBM as well as to deal with American companies which were denied to take part.

It was said that the French IRBM missile, probably in the 1,800-2,500 mi. range and armed by solid propellant, would be built with American technical aid and be armed with French nuclear warheads. It was to be ready by 1965.

U. S. aircraft companies, known to participate in French IRBM project, by the end of last August already were working out various projects with the French where as one source as Paris put it, "all hell broke loose." Since then, no further talks or information have been exchanged between the American companies or government officials and the French. At any, as official recognition—either from French or U. S. sources—has been made of the new situation. Apparently President Eisenhower's visit with Gen. Charles de Gaulle in Paris last September did not alter the U. S. decision. It was impossible to learn whether the U. S. ever actually intended to work with France on a bilateral basis on the IRBM project. One specification had it that the U. S. under a resolution passed at the NATO summit meeting in December, 1957, was willing to help the NATO group develop an advanced type weapon such as an IRBM, but wasn't ready to work on the bilateral deal.

U. S. companies, however, knowing France was interested in developing its own IRBM, began talks with the French about the same time, speculation was, that Washington stopped in and dropped those U. S. companies.





# ARPA Backs Solid Propellant Research

Washington—Advanced Research Projects Agency plans to increase the funding and scope of solid propellant research at the ARPA program goes into its second year.

Contracts, the first of which were awarded a year ago (AW, Nov. 3, 1958, p. 50), are aimed at the development of high-energy solid rocket propellants which reportedly would have specific impulses of approximately 150 sec. In all, ARPA let 54 contracts on an annual renewable basis.

Four of these contracts—the largest—for integrated research on oxidant and solid propellants—the cost, 20 cents for supporting research in these five fields: propellant performance, application methods, integrated research, high temperature research and basic research.

Funding for the four integrated research contracts last year totaled \$6 million; this year it will be boosted to approximately \$6.5 million. Contractors are Aero Research and Engineering Co., Dow Chemical Co., Minnesota Mining and Manufacturing Co., and American Cyanamid. ARPA has authorized increases of all four contracts. Actual contract negotiations are carried out for ARPA by the three military services.

Funding for the second year of the Dow contract, which is the only one of the four actually in the negotiating stage, has been authorized at \$2,248,000. Dow, which was awarded a \$4,000,000 contract by ARPA last year, will receive \$1,722,000 for its work for the forthcoming year.

Minnesota Mining, whose contract is up for renewal Feb. 1, will get \$5,515,000, and American Cyanamid will receive \$5 million.

ARPA's 50 supporting solid propellant research contracts will be renewed as they come up over the next few months at approximately their first year funding levels. Among the extramural organizations already approved are: At laster Research Corp., \$100,000 for specialized synthesis work—one of 18 in this field, New York University, \$105,000, also for specialized synthesis, Albany Buffalo Laboratory, (Hercules Powder Co.), \$155,000 for propellant performance research—one of 11 contracts in this area. Soon up for renewal and expected to be approved is ARPA's contract with Allied Chemical Corp., which last May received \$751,000 for research on high energy oxidizers.

In addition, ARPA research, agreed a new supporting solid-propellant research contract with Jet Propulsion Laboratory. Contract is for research in non-destructive testing and is funded at the \$1 million level. ARPA also

works in the process of negotiating another new contract on the "delagation to detonation phenomena." Funding for all contracts is available in ARPA's Fiscal 1960 budget, which went into effect last July.

The ARPA solid propellant research contracts are aimed generally at the development of "more energetic solids to which increase our present capabilities." Contractors are given cost objectives, rather than detailed specifications.

As the director of one temporary program in an integrated ARPA contract put it: "These contracts, at least the four integrated ones, are among the more intelligent contracts suggested by the government; they don't tie your hands or really limit you in any way."

In this program, ARPA is looking for breakthroughs rather than simple advances in solid propellant technology. Most of the contracts involve fairly basic research. Primarily for this reason ARPA chose its industrial contractors mostly from old line chemical and petroleum research companies which had established research with extensive backgrounds in related basic areas of chemistry, physics and combustion rather than from the solid propellant producers.

ARPA's solid propellant contractors negotiate close liaison and are kept up to date on each other's progress. The four companies holding the integrated contracts, for example, meet biweekly each quarter. ARPA and the three services are represented at these meetings by the four-member team.

## NASA Budget

Washington—National Aeronautics and Space Administration will cut 10 percent for "something under a billion dollars total" for its Fiscal 1960 budget, Assistant Administrator Richard L. Houser said last week.

A supplemental request for Fiscal 1960 also was not being considered last week. A major consideration in both a supplemental and the Fiscal 1960 budget is the cost of continuing the Saturn booster program.

Houser said the 1960 request will be between the half billion asked in Fiscal 1960 and one billion. The actual figure is believed to be approximately \$100 million (AW Nov. 16, p. 25). There has been speculation recently that the Fiscal 1960 request might be as high as \$4.2 billion. Houser's comments leave open the possibility that a supplemental Fiscal 1960 request plus the Fiscal 1961 request of less than a billion might produce a total in the neighborhood of \$2.2 billion.

In addition, contractors get together frequently on an informal basis.

Having started at essentially the same time last year, the four holders of the integrated ARPA research contracts today stand at roughly the same progress mark.

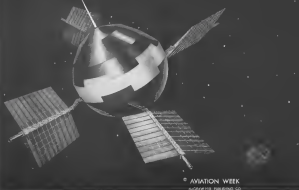
No ARPA contractor has come up with a new compound. That is expected to take another year or two and there is some disagreement as to what the end product will be when it is developed. Some contractors believe it is some alkyl to turn out to be a high-energy storable liquid propellant than the high-energy solid originally sought (AW, Nov. 24, p. 21). A high-energy, storable liquid, according to others, also is a possibility.

Whatever it proves to be, the new propellant is expected to make use of features in the existing designs. While it is possible to increase the energy level of all solid propellant contractors, most of the current research is being concentrated on the oxidizer. Because the oxidizer accounts for the largest percentage of the total propellant, ARPA contractors feel that improvements in this area will provide the best overall return on any research investment.

Not in a new compound but most of the ARPA contractors in this area are currently trying to get together to do the oxidizing job. Theoretically, it is the most energetic oxidizing element available—hot only in a gas or oxygenic liquid. When combined in a solid state, however, it is present because one of the most energetic materials in existence. This is the reason some ARPA contractors believe the program is more likely to result in a liquid propellant than the intended solid.

Regardless of the eventual outcome, contractors and ARPA officials agree that the results so far appear promising and justify continuation of the program during the next year. The four companies holding the integrated ARPA research contracts have concentrated on defining their areas of attack, determining just which types of compounds looked most promising. Now that they know what to make, they are trying to develop methods for their.

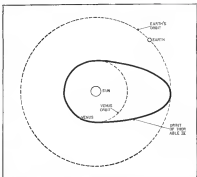
In another year, some contractors say, they could conceivably have a new solid propellant compound. Then they will have to scale up output—from 100 to 150 grams quantities—to get enough propellant to test. Their work will end with the successful testing of a small quantity of a new solid propellant. As previously planned, it will not be up to the current ARPA contractors to prove that their new propellants can be produced in large quantities or that they will perform as well in full-scale rockets.



Thor-Able IV interceptary probe will travel around sun with "pocket watch" rates extended for trapping solar energy.

## First Details of Thor-Able IV Solar Satellite

National Aeronautics and Space Administration's Thor-Able IV interceptary probe, projected for launch about Dec. 15 into a trajectory which will make it a satellite of the sun, will be approximately 26 in. in diameter and weigh 50-60 lb. Like Explorer VI earth satellite, it will carry low "pocket watch" time with solar energy cells. Thor-Able IV will not use Explorer VI's "pocket watch" such as surface to control the parked satellite temperature (see p. 53) but will use a simpler, post-launch release on the surface to maintain an internal temperature value between 50° and 60°. Because it will come so much closer to the sun during its elliptical orbit than did Explorer VI, it is likely that the additional solar cells also will have to incorporate a heat protection scheme. Space phenomena will be observed on 375.21 sec. then yielded to direct station in the tracking chain. Contributing to the NASA mission project is Air Force's Ballistic Missile Division, with its Thor missile data base; Ballistic missile launchers comply to an Air Force AB-110A second stage and Air Force's Ballistic Laboratory X-240A third stage, and Space Technology Laboratories, which is building and integrating the instrumented payload package. Weight limitations dictate that only one instrument and a few scientific experiments can be carried. Their first stage carries an geosynchronous, only an autopilot, and first and third stages carry no tracking instruments.



Satellite will orbit the sun in an elliptical path, with closest approach to the sun in the vicinity of the orbit path of Venus, and its greatest distance from the sun in vicinity of the orbit path of Jupiter. Perihelion will be about 66-67 million miles and apohelion about 93 million miles. Sun orbit will be about 300 days.

# McElroy Outlines Airborne Alert Plans

By Craig Lewis

Washington—Neil H. McElroy outlined a composite strategic defense concept for the next four years which could include a Boeing B-72 airborne alert as he left the Defense Department last week to return to private industry. McElroy revealed that the ground-work is currently being laid for an airborne alert capability during the fiscal 1961-62 fiscal year period so that it will be ready to join the Joint Chiefs of Staff defense plan which is expected to show an U. S. deterrent period during the years the Soviet Union has adequate missile power. Funds have been allocated for training and equipment needed to make an airborne alert feasible.

McElroy discussed the U. S. strategic defense concept for the airside gap period of a year conference held shortly after the White House announced the long-postponed defense program. McElroy had resigned from the President of the Defense. The former Defense Secretary left the Pentagon the same day his resignation was announced, and he is scheduled to return to Pacific & Cardale today to become chairman of the board after two years and two months in the Pentagon.

McElroy was replaced last week by Thomas S. Gates Jr., former deputy

secretary of defense. Gates, 53, a Philadelphia lawyer, has served in the State since 1957. He became undersecretary of the Navy in 1951 and later moved up as Navy secretary. He replaced the late Donald Quarles as deputy defense secretary last summer.

McElroy's last major job was to complete preparation of the military budget for fiscal 1961. McElroy said the budget sent to the White House for presentation to Congress is designed to hold U. S. defense spending close to the \$41 billion level. The total military budget, however, may be close to \$41 billion next year since foreign aid will be included for the first time.

Although he refused to discuss budget details, McElroy said that the Army Nike Zero anti-ICBM system will not go into production during fiscal 1961 but will continue with "very generous support of a research and development program." Other efforts of the U. S. budget defense began to improve against last week when USAF cut back its B-70 program (see page 26). McElroy said the Joint Chiefs have increased the general approval of the budget, but that they will not be asked to sign a letter endorsing it this year as they were required to do last year (AWM May 16, p. 20).

McElroy and the U. S. strategic defense capability is substantially higher

than it was two years ago and that the future is considerably less uncertain, primarily through development of tactical nuclear weapons. The former Defense Secretary repeated his earlier forecast that the U. S. and the Soviet Union would each build about 100 intercontinental ballistic missiles by the end of 1959. He said that, if "this build-out they could build and if we build out as we intend to build," Soviet atomic capability will be superior to the U. S. by 1961.

U. S. plans to maintain a composite defense force with Minuteman as common operational in 1961. The bomber force of the Strategic Air Command is a key element in this composite force. McElroy said, and provisions are being made to prepare for a possible airborne alert to keep part of the B-52 force secure from destruction on the ground.

McElroy said that the current training of an active component of long-range bombers, such as engines, so that the crews will be ready and the equipment in shape if the Joint Chiefs of Staff decide such an alert is necessary. Some funds are available in the current budget for this preparation, and some money is allotted in the fiscal 1961 budget.

McElroy pointed out that the life of the B-52 will be extended by the North American (Hawthorne) Dog ramjet. This 500-mile-per-hour ramjet can be launched from the B-52G and B-52H to destroy enemy defense installations and clear the way for bomber penetration of enemy defenses. McElroy said the B-52G and B-52H will be used in the Hound Dog test program with the bomb-carrying capacity of the B-52.

Discussing U. S. missile capability, McElroy said, "Today we are armed with the Atlas, the Titan, the Thor, and the Hound Dog test program with the bomb-carrying capacity of the B-52. It is not intended that Titan will continue in the program. The Polaris test last June, however, was a very successful one and is scheduled to be another part of the composite defense force, and Minuteman, and the submarines will go on station at the rate of about one every four months after the first one because operations in late next year. The Titan is scheduled. Polaris buildup will continue as far down the line as we can get."

While he described current ICBM as important deterrent elements, McElroy, however, said that the U. S. missile force is not yet a deterrent because it might be quickly suppressed by nuclear counterforce missiles. Future plans obviously depend heavily on successful development of Minuteman, and McElroy said the program is "re-

## President's Advanced Planning Views

Washington—President Eisenhower last week outlined his views of the need for concept and advanced weapons planning in reply to a question at a press conference on the eve of his departure to Europe. Following are the questions and the President's reply.

Q: Charles H. Mohr, Texas magazine—"Mr. President, this is a moment in history in which we have to maintain a large strategic capability in a sustained effort, and at the same time, pressing for the enormously expensive development of missile capabilities and also, we are going to have to develop a large strategic capability."

A: "I would like you could discuss and explain to us here, in such a manner as to point, the defense budget does not need to rise but can stay relatively stable over a period of two or three years."

Q: The President—"Well, I think that the first thing is this:

"Since you are going from one defense crisis, largely, to another, particularly in the matter of defense, it is old-fashioned to say that it is a 6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-100-101-102-103-104-105-106-107-108-109-110-111-112-113-114-115-116-117-118-119-120-121-122-123-124-125-126-127-128-129-130-131-132-133-134-135-136-137-138-139-140-141-142-143-144-145-146-147-148-149-150-151-152-153-154-155-156-157-158-159-160-161-162-163-164-165-166-167-168-169-170-171-172-173-174-175-176-177-178-179-180-181-182-183-184-185-186-187-188-189-190-191-192-193-194-195-196-197-198-199-200-201-202-203-204-205-206-207-208-209-210-211-212-213-214-215-216-217-218-219-220-221-222-223-224-225-226-227-228-229-230-231-232-233-234-235-236-237-238-239-240-241-242-243-244-245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000-1001-1002-1003-1004-1005-1006-1007-1008-1009-1010-1011-1012-1013-1014-1015-1016-1017-1018-1019-1020-1021-1022-1023-1024-1025-1026-1027-1028-1029-1030-1031-1032-1033-1034-1035-1036-1037-1038-1039-1040-1041-1042-1043-1044-1045-1046-1047-1048-1049-1050-1051-1052-1053-1054-1055-1056-1057-1058-1059-1060-1061-1062-1063-1064-1065-1066-1067-1068-1069-1070-1071-1072-1073-1074-1075-1076-1077-1078-1079-1080-1081-1082-1083-1084-1085-1086-1087-1088-1089-1090-1091-1092-1093-1094-1095-1096-1097-1098-1099-1100-1101-1102-1103-1104-1105-1106-1107-1108-1109-1110-1111-1112-1113-1114-1115-1116-1117-1118-1119-1120-1121-1122-1123-1124-1125-1126-1127-1128-1129-1130-1131-1132-1133-1134-1135-1136-1137-1138-1139-1140-1141-1142-1143-1144-1145-1146-1147-1148-1149-1150-1151-1152-1153-1154-1155-1156-1157-1158-1159-1160-1161-1162-1163-1164-1165-1166-1167-1168-1169-1170-1171-1172-1173-1174-1175-1176-1177-1178-1179-1180-1181-1182-1183-1184-1185-1186-1187-1188-1189-1190-1191-1192-1193-1194-1195-1196-1197-1198-1199-1200-1201-1202-1203-1204-1205-1206-1207-1208-1209-1210-1211-1212-1213-1214-1215-1216-1217-1218-1219-1220-1221-1222-1223-1224-1225-1226-1227-1228-1229-1230-1231-1232-1233-1234-1235-1236-1237-1238-1239-1240-1241-1242-1243-1244-1245-1246-1247-1248-1249-1250-1251-1252-1253-1254-1255-1256-1257-1258-1259-1260-1261-1262-1263-1264-1265-1266-1267-1268-1269-1270-1271-1272-1273-1274-1275-1276-1277-1278-1279-1280-1281-1282-1283-1284-1285-1286-1287-1288-1289-1290-1291-1292-1293-1294-1295-1296-1297-1298-1299-1300-1301-1302-1303-1304-1305-1306-1307-1308-1309-1310-1311-1312-1313-1314-1315-1316-1317-1318-1319-1320-1321-1322-1323-1324-1325-1326-1327-1328-1329-1330-1331-1332-1333-1334-1335-1336-1337-1338-1339-1340-1341-1342-1343-1344-1345-1346-1347-1348-1349-1350-1351-1352-1353-1354-1355-1356-1357-1358-1359-1360-1361-1362-1363-1364-1365-1366-1367-1368-1369-1370-1371-1372-1373-1374-1375-1376-1377-1378-1379-1380-1381-1382-1383-1384-1385-1386-1387-1388-1389-1390-1391-1392-1393-1394-1395-1396-1397-1398-1399-1400-1401-1402-1403-1404-1405-1406-1407-1408-1409-1410-1411-1412-1413-1414-1415-1416-1417-1418-1419-1420-1421-1422-1423-1424-1425-1426-1427-1428-1429-1430-1431-1432-1433-1434-1435-1436-1437-1438-1439-1440-1441-1442-1443-1444-1445-1446-1447-1448-1449-1450-1451-1452-1453-1454-1455-1456-1457-1458-1459-1460-1461-1462-1463-1464-1465-1466-1467-1468-1469-1470-1471-1472-1473-1474-1475-1476-1477-1478-1479-1480-1481-1482-1483-1484-1485-1486-1487-1488-1489-1490-1491-1492-1493-1494-1495-1496-1497-1498-1499-1500-1501-1502-1503-1504-1505-1506-1507-1508-1509-1510-1511-1512-1513-1514-1515-1516-1517-1518-1519-1520-1521-1522-1523-1524-1525-1526-1527-1528-1529-1530-1531-1532-1533-1534-1535-1536-1537-1538-1539-1540-1541-1542-1543-1544-1545-1546-1547-1548-1549-1550-1551-1552-1553-1554-1555-1556-1557-1558-1559-1560-1561-1562-1563-1564-1565-1566-1567-1568-1569-1570-1571-1572-1573-1574-1575-1576-1577-1578-1579-1580-1581-1582-1583-1584-1585-1586-1587-1588-1589-1590-1591-1592-1593-1594-1595-1596-1597-1598-1599-1600-1601-1602-1603-1604-1605-1606-1607-1608-1609-1610-1611-1612-1613-1614-1615-1616-1617-1618-1619-1620-1621-1622-1623-1624-1625-1626-1627-1628-1629-1630-1631-1632-1633-1634-1635-1636-1637-1638-1639-1640-1641-1642-1643-1644-1645-1646-1647-1648-1649-1650-1651-1652-1653-1654-1655-1656-1657-1658-1659-1660-1661-1662-1663-1664-1665-1666-1667-1668-1669-1670-1671-1672-1673-1674-1675-1676-1677-1678-1679-1680-1681-1682-1683-1684-1685-1686-1687-1688-1689-1690-1691-1692-1693-1694-1695-1696-1697-1698-1699-1700-1701-1702-1703-1704-1705-1706-1707-1708-1709-1710-1711-1712-1713-1714-1715-1716-1717-1718-1719-1720-1721-1722-1723-1724-1725-1726-1727-1728-1729-1730-1731-1732-1733-1734-1735-1736-1737-1738-1739-1740-1741-1742-1743-1744-1745-1746-1747-1748-1749-1750-1751-1752-1753-1754-1755-1756-1757-1758-1759-1760-1761-1762-1763-1764-1765-1766-1767-1768-1769-1770-1771-1772-1773-1774-1775-1776-1777-1778-1779-1780-1781-1782-1783-1784-1785-1786-1787-1788-1789-1790-1791-1792-1793-1794-1795-1796-1797-1798-1799-1800-1801-1802-1803-1804-1805-1806-1807-1808-1809-1810-1811-1812-1813-1814-1815-1816-1817-1818-1819-1820-1821-1822-1823-1824-1825-1826-1827-1828-1829-1830-1831-1832-1833-1834-1835-1836-1837-1838-1839-1840-1841-1842-1843-1844-1845-1846-1847-1848-1849-1850-1851-1852-1853-1854-1855-1856-1857-1858-1859-1860-1861-1862-1863-1864-1865-1866-1867-1868-1869-1870-1871-1872-1873-1874-1875-1876-1877-1878-1879-1880-1881-1882-1883-1884-1885-1886-1887-1888-1889-1890-1891-1892-1893-1894-1895-1896-1897-1898-1899-1900-1901-1902-1903-1904-1905-1906-1907-1908-1909-1910-1911-1912-1913-1914-1915-1916-1917-1918-1919-1920-1921-1922-1923-1924-1925-1926-1927-1928-1929-1930-1931-1932-1933-1934-1935-1936-1937-1938-1939-1940-1941-1942-1943-1944-1945-1946-1947-1948-1949-1950-1951-1952-1953-1954-1955-1956-1957-1958-1959-1960-1961-1962-1963-1964-1965-1966-1967-1968-1969-1970-1971-1972-1973-1974-1975-1976-1977-1978-1979-1980-1981-1982-1983-1984-1985-1986-1987-1988-1989-1990-1991-1992-1993-1994-1995-1996-1997-1998-1999-2000-2001-2002-2003-2004-2005-2006-2007-2008-2009-2010-2011-2012-2013-2014-2015-2016-2017-2018-2019-2020-2021-2022-2023-2024-2025-2026-2027-2028-2029-2030-2031-2032-2033-2034-2035-2036-2037-2038-2039-2040-2041-2042-2043-2044-2045-2046-2047-2048-2049-2050-2051-2052-2053-2054-2055-2056-2057-2058-2059-2060-2061-2062-2063-2064-2065-2066-2067-2068-2069-2070-2071-2072-2073-2074-2075-2076-2077-2078-2079-2080-2081-2082-2083-2084-2085-2086-2087-2088-2089-2090-2091-2092-2093-2094-2095-2096-2097-2098-2099-2100-2101-2102-2103-2104-2105-2106-2107-2108-2109-2110-2111-2112-2113-2114-2115-2116-2117-2118-2119-2120-2121-2122-2123-2124-2125-2126-2127-2128-2129-2130-2131-2132-2133-2134-2135-2136-2137-2138-2139-2140-2141-2142-2143-2144-2145-2146-2147-2148-2149-2150-2151-2152-2153-2154-2155-2156-2157-2158-2159-2160-2161-2162-2163-2164-2165-2166-2167-2168-2169-2170-2171-2172-2173-2174-2175-2176-2177-2178-2179-2180-2181-2182-2183-2184-2185-2186-2187-2188-2189-2190-2191-2192-2193-2194-2195-2196-2197-2198-2199-2200-2201-2202-2203-2204-2205-2206-2207-2208-2209-2210-2211-2212-2213-2214-2215-2216-2217-2218-2219-2220-2221-2222-2223-2224-2225-2226-2227-2228-2229-2230-2231-2232-2233-2234-2235-2236-2237-2238-2239-2240-2241-2242-2243-2244-2245-2246-2247-2248-2249-2250-2251-2252-2253-2254-2255-2256-2257-2258-2259-2260-2261-2262-2263-2264-2265-2266-2267-2268-2269-2270-2271-2272-2273-2274-2275-2276-2277-2278-2279-2280-2281-2282-2283-22

## AIR TRANSPORT

# Jets Spur Transatlantic Passenger Rise

Airlines foresee one-third increase in seats next season, as 12 carriers phase jets into service.

By Glenn Garriss

New York—Airline capacity on the North Atlantic, which rose little last summer in seat carriers mailed for their jets, is expected to increase by about one-third next season as 12 airlines will be offering jet service.

Most current reported good results for the 1979 peak season although many were holding the line in seat capacity, as predicted by *Airways Week* (Mar. 4, p. 46). Scheduled International Air Transport Assn. airlines offered 916,973 seats on the route during the June-through-September period, an increase of 4% over the same period of 1978.

Passenger revenue totaled 93,976, an increase of 12.9%. In spite of cost-cutting, capacity increased 47% in the summer of 1978 over the summer of 1977 and the passenger increase was 15%. Many carriers in 1978 were adding new seats of their latest-model piston fleets.

For the first time summer of 1979, the passenger total was up 10% to 991,475, topping the airlines mark for the first time so early in the year. Capacity for the next month rose 5% to 1,678,505 seats. Overall passenger load factor for the first-month summer as of 1979 was 75%, up from 68% the previous season.

Piston-fleet passengers totaled in the 1979 summer period totaled 121,167. The summer total was 544,169, comprising transatlantic routes and passenger accounted for 28,350 occupied seats.

### Transatlantic Period

Only Pan American World Airways and British Overseas Airways Corp. had jets in their transatlantic fleets during the entire summer 1979 period, but only four of the 16 IATA airlines on the run will jet back next summer. Most of the new Douglas DC-8s and Boeing 707-420s and 420s will begin appearing in service next spring. Jets will dominate the North Atlantic next summer, and the carriers face this transitional period with some uncertainties.

Filling the expanded capacity, which as *Airways Week* source indicates may total 1,274,000 seats next summer, will rely for strenuous competitive sales efforts to find the market. Bargaining prospects on both sides of the Atlantic is hoped online. The jets, however, with their new standards of comfortable flight and their more-chopping speeds, should stimulate new sources of business. But whether all carriers will be able to keep their expensive new jets

busy enough and full enough to make them pay during the first jet season is a question everyone wishes he could answer. Forecasts to Airlines Week of ticket increases ranged from 15% on up to a doubling of the business.

Rate increases still is uncertain because of the breakdown of IATA into three separate organizations in Atlantic (AW Oct. 11, p. 40). As things now stand, there will be no official IATA fare or other agreement in effect on the Atlantic after Apr. 1. However, most airline officials feel that to operate a route will come about. Either the carriers will hold a special meeting, probably after next year, and come up with a transatlantic IATA agreement, or the status quo will probably obtain. In any case, however, the carriers in a quiet special meeting will be faced with little change in fare except that the jet services probably will be eliminated.

At Air Union, the cooperative program among four European operators, would change the competitive balance of its effects were left intact now. But it seems unlikely that Air Union's plan, which is still in an early stage of development, will be implemented. The union, as in 1968 is concerned its members—Air France, Alitalia, Sabena and Lufthansa—will proceed with their individual, competitive sales drives for next year's transatlantic business.

### Summer Trend

The post-trend's overall trend toward holding the capacity closed to previous levels was by no means uniform, and the picture varied considerably among individual carriers. The two operators of jets during the period, for example, took different approaches, with Pan American cutting capacity and BOAC increasing capacity substantially. Here are examples of individual results

for the June through September, 1979 period and tentative outlooks for 1980:

• Pan American achieved a spectacular load factor of 56% for the period, raising its capacity by 9% and yet carrying 14% more passengers than during the same four months of 1978. Load factor for the 1978 period was 49%. Seats offered in the 1979 period totaled 149,199, up to 74,747 on the eastbound and 74,622 on the westbound. Passengers totaled 128,768—62,677 on the eastbound and 66,096 on the westbound. The carrier offered 55% of its seats in Boeing 707-420 jet equipment during the period. Next summer, Pan American expects to increase its capacity by 15,200 on the route, with jet capacity comprising about 92% of the total. The carrier plans to operate 40-45 transatlantic round trips a week at the peak of summer 1980, exclusive of the West Coast-Europe (jet) route.

Its Boeing 707-420s, already phasing in to the North Atlantic operation as well as other routes, will probably be augmented by other jet equipment. Lufthansa Douglas DC-8s from National Airlines under Pan American's and National's reciprocal agreement, and/or Pan American's own DC-8s, which will start arriving next spring for assignment to the carrier's domestic. Pan American's estimate of the market response next year is 15% for the North Atlantic. At the peak of the season, peak loads could have to get as high as between next summer's traffic will provide a demand for piston as well as jet seats. Pan American's DC-8s in a typical configuration, will seat 16 in first class and 87 economy passengers, a total of 103.

• BOAC took a different course from Pan American's last summer, increasing capacity by 51% and carrying 42% more passengers for a total of 162,921 seats. The carrier's summer load factor for the period figures indicate BOAC's transatlantic operation from London. Load factor was 68%, a drop from 75% during the same 1978 period. The British carrier provided 70% of its capacity in its Comet 4 jets and also operated the out-of-pocket British Airways and the Douglas DC-7C. The Comets were used to do first and first class and economy configurations, with tourist and economy passengers carried in the rear of the aircraft. Comet load factor for the period was "lightly under 90%." BOAC and First-class passengers in all equipment for the period totaled 24,355 and first-class seats totaled 34,965, for a first



First Lufthansa Boeing 707-420 Rolls Out

First Boeing 707-420 International jet transport for Lufthansa German Airlines is rolled out from the Boeing Airplane Co. plant at Renton, Wash. Airlines has ordered four International planes, plus will enter its first flight this month and will be delivered late in January. Forecasts are for four Boeing 707-420s Boeing before spring.

class load factor of 69%. Although most airlines had dropped their transatlantic accommodations by last summer, BOAC offered 24,362 seats in this class, earned 14,482 tourist passengers. Economy capacity was 96,000 seats and passengers totaled 69,610. BOAC plans to offer about 45% more peak capacity next summer than during the peak of 1979.

Its Rolls Royce Conway-powered Boeing 707-420s will be phased onto the route beginning next January, and Comets will be phased off the run with a week of the Boeing jet transport replacement.

### British Outlook

Outlook, for filling the scheduled capacity, a "promise" in BOAC's view, and the carrier already has bookings which indicate a 50% increase in charter passengers during the year. Charter will be flown in all types of equipment including the new jets.

Trans World Airways, which has just inaugurated its first transatlantic jet service with Boeing 707-420s (AW Nov. 16, p. 41), will back its summer 1979 capacity to 367,310 seats, compared with 138,728 the previous summer. Passengers totaled 76,561, down from 87,723 during the same period of 1978. Months of TWA's transatlantic first jet summer was the Lockheed 1649A Constellation. During the period July 3 through Sept. 26 of 1978, TWA offered a peak of 45 round trips a week.

Next summer, the airline expects a peak of only 40 weekly round trips on the North Atlantic, but 15 of them will be in the big jet and peak weekly capacity is expected to total 117,790 seats in both directions, compared with

6,922 seats last summer. The other four round trips will be flown in 1649As, and these aircraft also will connect with the jets at oceanic gateways. TWA forecasts a passenger increase of 50% for the year 1980.

### KLM Increase

KLM Royal Dutch Airlines increased its traffic by 21% to 61,977 passengers in its capacity went up only 13% to 81,296 seats. The carrier expects a 15% increase in both seats and traffic for next summer. First transatlantic jet service with DC-8s is planned Apr. 1 with a daily round trip between New York and Amsterdam.

Four jets, 1 on KLM expects to schedule two daily DC-8 flights and two daily DC-7C flights, the latter carrying economy and first class seats and berths. The carrier has one of four 47H plane in transatlantic passenger service in fourth place, on the basis of summer 1979 figures.

Scandinavian Airlines System increased its transatlantic capacity very slightly during the four-month period from 85,448 to 88,000 seats, showed a low traffic increase from 58,257 passengers in the summer of 1978 to 58,443 passengers last summer. Next year it will step up capacity by 30-35%, as according to present tentative plans. Like Pan American, SAS believes the industry can expect an increase of about 15% in passenger traffic.

The Scandinavian carrier plans to make the most of its Sud Caravelle jet connections with its transatlantic DC-8s. With five equipment combinations as one of its plane sales took, SAS expects confidence it can achieve high load factors with its transatlantic jets, and also expects to fill enough piston

seats to make an DC-7C flight profitable.

It will start phasing jets onto the Atlantic in April and expects its piston services to end around the middle of next September.

In July, SAS may be offering 13 weekly jet and seven weekly piston schedules.

Air France offered 69,364 seats, up 10% from the 1978 period. Traffic increased 17% to 56,264 passengers. Of the 1979 capacity, 77,621 were in economy seating. The carrier estimates a capacity increase next season of 60%.

Boeing 707-320 service is scheduled to begin from New York Jan. 25 with daily flights, and in next summer peak-flight service is planned with three daily flights.

By Apr. 1, jet schedules will be the piston route from Los Angeles via Montreal, and Chicago will be served by the 707. At that time, all of Air France's transatlantic services will be jet.

The carrier's 30th will carry 12 to five and 100 economy passengers.

### Other Sell

Head sell plan include Pan-Am-Airways-TWA service beginning Feb. 2 with the 320. Like SAS, Air France will be its Boeing-Comet combination hard. Air France has its Caravelle flying, expects its order of 24 to be completed by the end of next year. Next long after, the carrier plans to be serving 88 cities with its jets: 42 with the Caravelle and 39 with its 707 Boeing.

Lufthansa German Airlines boosted summer 1979 capacity in 24% over the previous season, carried 23% more passengers. Totals were 47,478 seats

and 31,661 passengers during the 1999 period. Lufthansa's first Boeing 707-420 is scheduled to enter transatlantic service Aug. 1 from New York and Chicago, and polar jet service from San Francisco beginning May 10.

The airline will have three of the big jets in operation next summer and four next fall. It plans to operate three weekly flights out of Chicago, seven out of New York and two out of San Francisco of the peak, and to add flights with 169A equipment when necessary.

Belgian Belgian World Airlines cut back capacity 11% following a special expansion the year before in connection with the Brussels Fair. Seats during the 1999 period totaled 53,536 and 39,006 passengers were carried, a drop of 18% from the previous season. Sabena's 707-320s are scheduled to appear in North Atlantic service Feb. 11 with four weekly round trips, which will be supplemented by three weekly DC-7C flights. The airline expects to schedule 14 weekly jet flights at the peak.

Swire will step up its transatlantic capacity, especially on its DC-8s. Stage planning is, with first service tentatively scheduled for May 6 with three weekly New York-Zurich schedules. Nine to 12 weekly schedules are planned for next year's peak when the carrier's three peak has been reduced.

Swire will be the third carrier to be transatlantic jets in with its own Caravelle jet schedules (AW Nov. 23, p. 45). During the four-month period of 1999, Swire's capacity ran up only slightly to 35,671 seats, compared with 27,942 during the 1995 period. Passenger load rose from 20,465 to 21,874.

Trans Canada Air Lines plans to put its Cancon-powered DC-8 on transatlantic domestic service May 1 and

to offer DC-8 service on the North Atlantic beginning April 1. Last summer the airline offered 33,371 seats and carried 30,999 passengers for a load factor of 93%. Totals for the 1995 period were 37,010 seats, 29,245 passengers, load factor 79%.

Qantas Airways introduced two weekly Boeing 747-300 jet services in September as part of its new, month-of-the-month jet service. With two weekly round trips and no originating base on the Atlantic shores, Qantas carries a very small percentage of the transatlantic traffic. If frequencies are stepped up next year, they will still be a part of the global service.

Four of the 16 IATA airlines on the North Atlantic will have next summer without jet equipment. Irish Air Lines, which entered the transatlantic picture in May, 1998, with leased Lockheed 1049H equipment, expects delivery of its first leased Boeing 737 next fall. In the meantime, it will continue to offer an all-cargo service on the route.

Canadian Pacific Airlines, which has been flying Britannia four times a week from Vancouver, B. C., to Amsterdam and DC-8s from Montreal to Seattle, Maine, London and Madrid, has ordered four Cancon-powered DC-8s and expects the first delivery in December, 1999. During the interim, the Cancon carrier will get in some good work on a growth way state to Rome, with first scheduled stop for May 1. Britannia will fly that route, which is an extension from London.

There's Airbus of Spain has ordered three DC-8s and hopes to get the first in June 1999. The carrier operated four weekly Lockheed Super G Constellation round flights on the North Atlantic last summer, and it did in 1998. It plans to increase next year by stepping up promotional and sales plans to prepare

for the jet transport competition.

El Al Israel Airlines has announced it will buy five jets of U.S. manufacture in 1997. In the meantime, it will rely on its Britannia which carried 9,261 passengers last summer, against 12,616 passengers in the same period of 1996. Capacity totals were 18,770 seats in summer 1999, and 12,796 seats the previous period. El Al feels it will hold its own with its direct service to Israel and reports loadings better than last year's. In its weekly flights may be increased by one next summer.

## Flying Tiger Seeks Swing-Tail Tariff

Los Angeles—Research groups to lead toward lowering air freight rates to competitive levels with rail, truck and rail freight rates is being conducted by Flying Tiger Line and Consolidated Ltd. The joint administrative program will have a supporting budget of approximately \$200,000 for the next year.

Flying Tiger, with its fleet of 34 Canadian CL-HD4s (AW Sept. 7, p. 15), is the largest air freight carrier in the world. The program will seek a breakthrough into freight rate areas on an average of 30 to 40% under today's existing rates.

Canadian and Flying Tiger believe that rates in less than 4 cents a ton mile are possible with the CL-HD4, and that at an average rate of approximately 33 to 34 cents, equipped with the existing average of 18-19 cents, rate has been increased since last year. Last year, it was estimated that such rate levels should create an air freight market from 7 to 10 times today's volume.

The research program has two phases: • Analysis of the characteristics of cargo presently being handled by Flying Tiger.

• Identify, locate, measure and determine characteristics of commodities which have no potential and can move by air rather than water.

Phase I of the program has been completed and work on Phase II is well under way, according to Flying Tiger. Involved in Phase II are studies of value volume movement, weight, destination, bulk, density, origin and destination, directional movement and distribution costs of potential air cargo.

For several months, Flying Tiger has had a research staff working under the direction of Robert L. Bremer, manager of the airline's rates and tariff department. Keith A. Miller, manager of Canadian's sales research staff, will join Bremer for the study. Stanley Besset, professor of transportation for the University of Western Ontario and Roger B. Chaboud, professor of transportation for the University of California at Los Angeles, have been retained in consultants



Boeing 720 Medium-Range Jet Makes First Flight  
Boeing 720 medium-range jet transport (AW Nov. 16, p. 40), making its first flight from Renton Municipal Airport, Wash., is the first of 16 for United Air Lines. Aircraft is powered by two Pratt & Whitney JT8C-7 engines, each developing 12,800 lb. thrust. Aircraft will be delivered to United next April. 25 are being ordered by American Airlines and then by Irish Air Lines. Plans is 5 ft 4 in. diameter engine and add to transport wing 10.

## ICAO Studying Traffic Data Exchange

By Paul Egan

Washington—International airlines' long-standing controversy over the exchange of passenger origin and destination reports is leading to a clause with a concerted effort to bridge one of the widest gaps in world airline schedules.

A move to try and take the problem is being undertaken through the International Civil Aviation Organization, which has appointed an ICAO panel to study the feasibility of a substantial organization and distribution exchange, review the background of the dispute and submit proposals for a workable agreement. The panel's next meeting is scheduled for May.

### Difficult Task

The task of recommending a plan that would be acceptable to all the airlines concerned will be difficult. Flag carriers from the Scandinavian countries, the Netherlands and Belgium are strongly opposed to the exchange. Others, including those of the United Kingdom, Israel and the U.S., are equally strong in their support.

Airlines have exchanged traffic figures in the past, but this was abandoned about ten years ago on grounds that they served no useful purpose, at least partly because many carriers failed to

respond directly to all the information requested. The U.S. was one of the nations that voted for discontinuance of the reports.

The type of reports now sought by proponents of the exchange is a first origin and destination report, which opens the passenger's ticket that would show where he first boarded the aircraft and the route taken to his destination. Then, they say, would be advantageous to all airlines in future planning for the establishment of new offices, flight frequencies, schedules and routes.

Those opposed to the plan argue that such reports would be time consuming and costly and would not be as helpful in airline operations. However, these carriers did indicate that they would agree to furnish reports on the number of passengers traveling between their respective countries and other nations—a plan similar to the earlier reports that were discontinued.

Some of the foreign carriers opposed to the exchange also have indicated that they might agree to exchange origin and destination reports with the U.S. if, in return, the U.S. would agree to additional route concessions. This is strongly opposed by most American flag carriers who contend that foreign airlines already have access to a greater potential market in the U.S. than U.S. carriers have access in re-

turn. U.S. international carriers not affected by the passing of additional route concessions to a foreign nation might be inclined to support this proposal in order to get an agreement for an exchange of the reports.

Under the ICAO program, however, this type of bargaining would not be an issue, and any agreement reached would have to be made solely on the merits of the exchange and the ability of the panel members to clear any doubts at its disposal.

### U.S. Belief

U.S. flag carriers contend that the real opportunity to the exchange of origin and destination reports based on origin and not on route numbers, is that it would reveal any violations of the capacity limits incorporated in bilateral air agreements.

The capacity issues in a Bernadotte treaty agreement provide that the air services made available to the public by the airlines designated to operate between the two countries shall have a close relationship to the requirements of the public for such services. This is termed Third and Fourth freedom traffic.

At the same time, the Bernadotte principles provide that the airlines have a right to embark or disembark international traffic destined for, and coming



## First TEAL Electra Makes Delivery Flight

First TEAL Electra Lockheed Electra being transported for Tainia Airline Airways, Ltd. (TAA) leaves Lockheed, Calif., on delivery flight to Auckland, New Zealand. TEAL Electra carries 61 passengers. Plans, one of three Electra ordered, will start service the month, two others will be delivered by year-end.

# FIRST AGAIN!



## Air France—First European Airline to Fly Giant Boeing 707 Intercontinental Jets Across the Atlantic!

Here's another Air France "first" for the record! Soon Air France's Boeing 707 Intercontinental Jet will touch down at Orly Field after a 6½-hour non-stop flight from New York. This flight will mark the beginning of the world's first "jet-to-jet" service—intercontinental jet non-stop daily to Paris, Conville jets from Paris to all Europe, Africa and the Middle East.

Air France is no stranger to the pages of aviation

history. As early as 40 years ago, Lucien Bossuot made the first international commercial flight between France and England. Similar historic first flights include the first crossing of the South Atlantic, the Andes, and the first scheduled Far East service.

The inauguration of transatlantic jet service demonstrates the forward steps that have helped make Air France the world's largest airline, with the world's most personal jet service.

# AIR FRANCE JET

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here, third countries at points on routes specified in the agreement so that services provided by the local or regional airlines on the line are taken into account. This is known as Fifth Freedom traffic and is generally considered a secondary objective in establishing the route, but it is one of the biggest problems confronting international airlines.

More recently, however, a new angle has been injected into the dispute, primarily by European carriers, who are complaining what they term South Freedom traffic. This, they say, is traffic that is brought through an airline's country en route to a second country. For example, a passenger board for Paris who is boarded in Mexico by Pan American, World Airways and taken to New York en route to Paris would be South Freedom from Mexico to New York, according to the European airlines, and the same in Third and Fourth Freedom traffic from New York to Paris. This would prevent carriers to develop the Fifth Freedom clause restricting the number of passengers that can be carried.

U S carriers do not agree with this interpretation. They maintain that traffic originating from the U S and bound for France en route to Paris in Third and Fourth Freedom traffic for which the U S and French carriers can compete. All other traffic not originating in or destined for either of the two countries is Fifth Freedom, this says.

### Traffic Flow

Traffic originations and destination reports would reveal the amount of traffic traveling between the two countries as well as the amount of traffic going to or coming from a third country. U S flag carriers are then have long suspected that a major portion of the traffic of some foreign airlines is being flown to go to a third country in violation of the capuch clause. U S carriers also have been charged with Fifth Freedom traffic violations. Airlines, nonetheless or other organizations that have been charged, would not necessarily do so voluntarily.

Supporters of the originations and destination report exchange feel that, while the reports would reveal the type

of traffic being carried by airlines, there are a number of other reasons for an agreement in this issue. One of the biggest problems, they claim, is the lack of understanding of the uses that could be made of the reports.

Disagreements, whose originations and destination reports are exchanged, they are used to support requests for additional service between pairs of points and to encourage traffic growth and keep many routes and service needs. The benefits of an exchange of figures that all international airlines could report are currently being provided by a joint industry-government group in a form of a report to be submitted at the May meeting of the ICAO 13-nation panel.

U S representative on the ICAO panel is Warren H. Hord, chief of the Office of Civil Aviation and Statistics of the Civil Aeronautics Board. Other nations represented on the panel are Argentina, Brazil, Denmark, France, Sweden, the United Kingdom, Spain, the Netherlands, Switzerland and Canada.

## 707-320s Improve Nonstop Capability

By William H. Gregory

London—Boeing 707-320 series Intercontinental jet transports are crossing the Atlantic westbound nonstop 75-80% of the time and operators report the airplane's range capability is not in question on the trips which require a fuel stop.

Below-average weather at destinations is the prime cause of unscheduled stops. However, a Federal Aviation Agency requirement for increased reliability speeds on takeoff for the airplane (AW Sept. 24, p. 48) has raised wing area runway performance and also has affected the nonstop performance.

Takeoff speeds have never been restricted by FAA and the fuel systems are 5-55 instead of the 7% interim figure.

Trans World Airlines' Flight 701 which left New York with a 100% load factor during the inaugural flight to Europe (AW Nov. 30, p. 41) was a good example of how the airplane will operate the westbound transatlantic route in winter conditions.

### Fast 707-321

The airplane, serial No. N785TW and powered by four Pratt & Whitney JT4A-3 turbojets, is the first of the 707-321 series being delivered to TWA. It carried 38 fuel crew passengers, 99 economy, three pilots, flight engineer, purser, three press and two stewards.

Because the length of the takeoff

runway 23L at London Airport is only 9,576 ft and because of the IAA rotation speed requirement, the maximum allowable gross weight of the aircraft was reduced to 80,000 lb, to 78,000, 600 lb.

Actual takeoff gross was 78,007 lb with a fuel load of 124,400 lb, about 15,000 lb less than the 140,954 lb allowable. Since the aircraft was not in excess 100 lb, on the great quick route to New York, a stop was planned at Gander and the fuel load reduced slightly more than necessary to Gander without using fuel.

The 45 sec takeoff required an estimated 7,500 ft of runway before liftoff. Nose was rotated at 155 ft, and the airplane was airborne at 164 ft.

### Cruise Altitude

Initial cruising altitude was 36,000 ft, later raised to 39,000. True air speed was 470 kt. Actual track selected was about 100 mi north of the great circle course in hope that the actual headwinds would be less than forecast.

This possibility turned into reality. Greatest speed on the London-Gander stage averaged 495 kt, making the average headwind component 57 kt. Since Gander weather was good, the New York and Boston were open, the flight cleared to eliminate the Gander stop and continue to New York International Airport at Idlewild with Boston in alternate open though increased

headwinds were forecast.

Ground speed dropped to 310-315 kt, indicating a 130 kt headwind component. Six-000 model gust predictions were not indicated, true air speed to 405 kt or less between Gander and Idlewild to save fuel, which was averaging about 12,000 lb/hr.

The flight landed with 88,900-112,000 lb fuel aboard. Idlewild is 8 ft to 13 mi from London-takeoff to touchdown.

### Fuel Stop

In its first week of 311 operations, one of TWA's three westbound transatlantic flights stopped at Gander for fuel. This flight, the first one westbound with the larger airplane, met the continuation of Idlewild cleared by weather and the accuracy of using Pittsburgh as an alternate, which would have required fuel on board at New York of 34,000 lb.

In contrast, the first eastbound flight which opened the 311 airplane took off from Idlewild at 24,000 lb gross and with 327,000 lb fuel, a 58-sec takeoff using 4,400 lb of runway 13's 11,000 ft. At a cruising altitude of 33,000 ft the airplane climbed at 485 ft. TAS, a ground speed of 575 kt. New York Idlewild flight used 14,000 lb to touchdown, was 4 ft, 8 in.

Pan American World Airways, which put the long-range Boeing rule service last, has been operating its 707-321s in scheduled transatlantic service since

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## First Eastern DC-8 Jet Transport Rolled Out

Eastern Air Lines' first Douglas DC-8 jet transport, equipped with Pratt & Whitney JT5 engines, went on completion outside the Douglas plant at Long Beach, Calif. The airline plans to put its first DC-8 schedule on its New York-Miami run in mid-January, 1968, to meet jet competition from two other carriers. Eastern does not plan to use water jet engines with the JT5s.

On Oct. 10, Pan American's seventh record.

- Westbound, London-Midland, 17 out of 22 flights nonstop, Pan-Midland, 15 out of 20 flights nonstop
- Eastbound, Midland-London, 21 out of 22 flights nonstop, Midland-Pan, 16 out of 15 nonstop

Pan America and the lengthening of the London services by 1968 and the elimination of the 7% reduction speed penalty should help the situation on this route. Pan America is operating again at Osh Field in Paris, where service length of 10,500 ft is available.

Though water would still undoubtedly not show any improvement—those encountered on the TWA flight was higher than annual for this season—Pan American believes it may benefit on the balance from colder temperatures as far as fuel load is concerned. Next summer might be a problem at London, however.

Pan America says payloads have not suffered and one of the early 321 flights carried what was reported as a record payload of 56,930 lb. on a commercial scheduled flight.

Pan America says it has been able to operate the airplane at maximum economic cruise of Mach .82 with a fuel consumption of 2,100 gph. or about the same as the 12,000 lb. he noted on the TWA trip. This makes for a London-New York schedule of 7 hr 55 min flight time, which allows for unfavorable winds, and Pan American says it has been operating as

smoothly within this schedule.

Pan American has 12 of the 321s, six in the Atlantic Division, four in the Pacific and two not assigned and which are now in Miami for modification. The Atlantic airplanes are operating a New York-London and a New York-Paris-Rome schedule. TWA has 12 of the 321s; an order for 12 more will be used on New York-London-Frankfurt and New York-Paris-Rome schedules. The three others are unassigned now, but might be used in service to Spain or Greece and beyond.

Now operating three flights weekly—

## TWA and Sir Frank

British newspapers are united at BOAC is leaving Trans World Airlines give Sir Frank Whittle Britain's pioneer in development of the turbojet engine, his first jet transport flight. Sir Frank was pilot of TWA's on its first London-New York Boeing 707-321 flight.

The Evening Standard said Sir Frank had now sailed BOAC to go along on a de Havilland Comet passenger flight, but was refused. The paper quoted a BOAC spokesman as saying:

"Sir Frank could be our jet adviser in or seven years ago. I couldn't possibly check if he asked to make a flight before then. And so in fact he never has been asked to come."

The paper added:

"We are in the way of publicity, TWA didn't wait to be asked."

New York-London-Frankfurt and New York-Paris-TWA will go to only schedules New York-Paris-Rome Jan. 10 and to New York-London-Frankfurt Jan. 17. TWA will make available one airplane of this group to Northeast Airlines on days a week, beginning Dec. 17, but unlike the Pan American National base exchange, this will continue through the summer.

Schedule summaries call for two daily round trip flights on each of the two routes beginning Jan. 3. A typical schedule calls for Flight 800 to leave Midland at 7:30 p.m. and arrive Rome at 10:15 the following morning (local time). The flight turns around at Flight 801, leaves Rome at 2:15 p.m. and is scheduled to arrive Midland at 7:40 p.m.

Outgoing the schedules with the Northeast have said not more are close timing problems. Even with only the four airplanes TWA will have to carry out the two-day-flight schedule in January, TWA will have two airplanes leaving even from arrival one night until departure the next. TWA will give Northeast one airplane in the morning for a flight leaving for Miami at 9:30 a.m. and returning at 1:30 p.m.

The London and Frankfurt route will become all-jet but the Northeast will be used to supplement the Pan routes. The airline reports that its jet transatlantic flights are already booked 50% for next June, indicating next summer may be a big one for transatlantic operators with jet equipment (see p. 36).

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# FAA Sets Pilot Age Limit, Tightens Rules

By Robert H. Cook

Washington—Federal Aviation Agency last week issued a mandate requiring airline pilots to retire at the age of 60 plus new regulations calling for FAA special of airline training programs and tighter cockpit qualifications in a move expected to touch off a new round of labor-management disputes that could have far-reaching effects.

There was discussion between the FAA, the airlines and the Air Line Pilot Assn. (ALP) Oct. 5, p. 38) could become even more acute, depending upon the outcome of a public hearing scheduled by the agency for Jan. 7 on a proposed regulation that would limit jet transitional training to airline pilots under the age of 55.

FAA's intention that it formulated the new regulations in an effort to ensure flight safety to have down conflict in a way from both the pilots and management. The airline agree with the mandatory retirement age, ruling but join with ALP in opposing the proposed jet training age restrictions as being too harsh on safety and in being too costly to implement. At the same time, the pilots' union is backing FAA's stand on training regulations, which it has sought for some time, and disagrees with company contentions that the rule is too costly and unrealistic in the interest of safety.

As outlined by the Federal Aviation Agency, the new regulation requires these measures:

- Establishment of age 60 as the mandatory retirement age for airline pilots, effective next Mar. '75.
- Approval of all airline training programs by FAA.
- More comprehensive training for airline pilots.
- Proficiency checks for pilots over 12 months under the direction of either FAA or a designated company check pilot.

Training regulations will become effective on Jan. 1, 1975, in order to provide the current sufficient time to obtain approval of their training programs and to qualify commands under the new regulations. Airlines must submit their training programs for agency approval by next Feb.

Announcement of the automatic retirement age brought a sharp, worded protest from ALPA which said it intends to challenge the ruling in the federal courts by asking an immediate injunction against the action, which it termed part of the "coercive" power of the FAA. An ALPA spokesman also said the extent of the agency's authority to issue such rulings should be

investigated and defined by the next session of Congress.

Attacking the age regulation as "arbitrary and capricious," ALPA repeated earlier claims that there is no medical basis for such action and charged that FAA had refused to permit the pilots' union to examine the evidence upon which the regulation was formulated and also had refused to hold a public hearing on the matter.

ALPA said the "retirement" age had been "poked out of a hat," was not based on flight safety and is "atrocious in industrial relations programs." The union also contended that FAA's stand is "clash at odds" with the overall philosophy of government studies in the relationship between age and ability. ALPA said the agency also has been expressed in letters it has received from several senators and congressmen, who, the union said, indicated that the FAA plan is "unrealistic and costly" to public policy.

## Wage Demands

Industry observers believe that out-come of all the new regulations, plus the proposed transition age limitations, is almost certain to trigger a new series of wage demands by the pilots who estimate that members will lose earnings and fringe benefits of \$200,000 a year over the age restriction on jet training. Combined with possible union demands for a lowering of month jet flight hours which would require more flight personnel, the addition of third class jet seats, maintenance and increased training costs, the group of regulations could result in demand for additional fee increases by the carriers who now are awaiting a final decision from the Civil Aeronautics Board in the General Protective Fair Competition. The airlines, an industry source will jump by \$25 million per year.

However, the retirement age regulation, the Federal Aviation Agency said, is based upon medical facts that sudden incapacitation due to pilot heart attacks and strokes become increasingly more frequent in an age group approaching 60 and cannot be predicted on an individual basis by prior medical examinations.

While it has not been proven that age is a factor in air carrier accidents, the agency said that over 60 or over 65 pilots aged 60 or over occupied 4% of the fleet. This number, it was, could be expected to grow to 15% in 1967, with airline activity steadily showing a growing number of jet operations in the hands of the older pilots.

FAA believes that because of the medical facts already known which in-

crease a pattern of decreasing mental and physical ability with age, permitting pilots over 60 to remain in command of an aircraft coming up to 85% percent at speeds of 550 mph would be a hazard to air safety.

Operation of new jet aircraft by older, more senior pilots has boosted the average ages of jet pilots to a point considerably higher than that for the overall airline pilot groups. High speed performance of the aircraft, combined with their greater passenger capacity, the agency says, makes jet operations more critical and places a greater responsibility on the pilot.

Based on present knowledge, FAA made the regulations to support the 60 year retirement age.

- Increasing frequency of possibility of heart attacks and strokes after the age of 40 indicates that 25 of every 1,000 pilots over the age of 60 can be expected to suffer this each year.
- Pilots aged 55 or over required twice as long to qualify on the Boeing 707 jet transports as compared with those under 40 despite their greater experience.
- A recent study by the Federal Bureau of Investigation, FBI, showed that 55 to 75 occupied 37% of the seats requiring an average of 46 hr.
- Foreign air carriers already have established compulsory retirement ages as well as age limits for jet transport pilots. For example, KLM, Royal Dutch Airlines and Swissair require retirement at 55. SAS requires a 60 year retirement. Sabena, which has only 11 pilots over 45, is considering a retirement age limit for jet transport pilots at 55. For BAC, the age limit for jet transport is 55. For KLM, 47 for Sabena and 55 for SAS.
- Aircraft manufacturers and insurers other than airlines have no pilots over 60 and only two over 54 while a sample of 35 of the largest air-carriers in the U.S. shows that 15% of the pilots are over 54.

and companies which build commercial aircraft appear that their oldest airline pilot is 49. While the new regulations for air carrier training programs and cockpit qualifications "now rule in additional costs" to the airlines, FAA noted that the extra expense is "far outweighed" by the considerations of safety involved. The regulation is considered necessary, ALPA said, because although airlines previously had full control over their training programs subject to FAA inspection and must have excellent records, often failed to adjust the minimum safety criteria to the age of the pilots. The new regulations, it was, expected to be the training requirements of the Civil Air Regulations. Airlines will now be required to submit such programs for FAA approval and must seek approval of any subsequent changes.



PLACEMENT of de Havilland DH-121 turboprop engine pods forward of tail section shows airfoil shape in a wind tunnel.

## Area Rule Cuts DH-121 Drag Coefficient

By John Ternstedt

**London**—Use of the area rule concept on the rear fuselage of the de Havilland 121 jet transport to wind tunnel tests at Hatfield has dropped the drag coefficient 0.02 in the upper speed ranges, designers told *Aviation Week*.

Engine pods, although aft of the pressurized cabin structure, for safety and noise reasons, have been placed at

the forward of the fin as possible to achieve a smooth area distribution along the whole length of the fuselage (AW Aug. 31, p. 46). A further contribution is derived by shaping the top and bottom profiles of the side pods which act as air stream deflectors.

Acquisition of an own low speed and transonic wind tunnels at Hatfield has enabled the company to carry out an extensive model test program while the

basic design progressed, which was not possible with the Conquest jet transport. A switch to light alloy development models also speeded the test program and cut costs.

In the wing development program for the DH-121, many modified versions of right dihedral wing configurations were tested in both cruise and landing speed regimes. High speed tests were carried out on a number of rear fuselage sections.

### Severe Handicap

Lack of test wind tunnel facilities proved a severe handicap in the original Conquest design program when de Havilland had to depend solely on the Zurich aerodynamic Royal Aircraft Establishment facilities at Langborough. This situation restricted hand tests to the basic design proposal and no testing concurrent with the design program was possible. It was later charged to the wing leading edge being introduced without ground effect tunnel testing which led to the twisted stall condition associated with the first model of the aircraft.

Different wing configurations based on various combinations of root thickness rates of change of wing root incidence, and root profiles superimposed on them, have wing designs led to eight major wing models being tested. These wing sections were distinguished by position of the suction ducts. As a result of the extensive program de Havilland was able to raise the critical Mach number to 0.875 and reduce the drag coefficient by an increment of

0.014-0.03 over the cruising speed range.

The winging design adopted is regarded by de Havilland as being in line with basic flow and drag design philosophies and features a well-rounded leading edge to increase the critical Mach number and a thickened root section. Actual details of this section have not been revealed, but the company claims to have resolved conflicting aerodynamic and structural problems with better than conventional solutions in each of these two categories.

The company says it has evolved an outstandingly simple wing root structure, easy to make and maintain and extremely free from areas that are fatigue-prone.

### Leading Edge

The rounded leading edge, the subject of recent Boeing changes (AW Nov. 9 p. 42), has been part of de Havilland thinking since the design was conceived of four years ago.

But this, too, only goes one third of the way with this article, according to one of de Havilland's senior area designers.

The optimum flaring of the nose profile structure was required only by extensive detailed tunnel research work and testing.

Tests on another feature, of the DH-121—the hinged, dropped leading edge—conducted at Langborough, on the nose ribs and the drop character edge and enabled the span of the droop to be reduced to about 10 ft.

With light alloys instead of conventional metals, de Havilland claims

that a dropped edge is easier to engineer and does than that is more reliable because it is simpler and gives away nothing aerodynamically. De wing is simpler because the arrangement is free of flexible boxes needed to cover slots.

Commenting on the use of light alloy models, de Havilland considers that because being quicker and easier to make than steel models, they were much more easily modified. The metal proved fully adequate for development work, which is the opinion of workers at Hatfield, pointed to over-construction as the use of steel in this field, at least in Britain.

Some spin wing models were constructed from false side walls in the 2 ft. x 2 ft. high speed tunnel at Hatfield.

Only one model was used extensively in the investigation of shock wave patterns.

Landing and takeoff characteristics were investigated in the 9 ft. x 7 ft. low speed tunnel using a larger complete model.

A flat plate under the model was used to simulate ground effects. The plate was slatted ahead of the aircraft to limit the boundary layer underneath the plate.

### Satisfying Result

One of the most satisfying results of this phase of the test program at Hatfield is reported by the company as being the fact that when a larger complete model was assembled and tested in the 5 ft. x 9 ft. transonic tunnel operated by the Aircraft Research Association at Bedford, no subsequent changes were required.

## Higher Jet Rates Asked by Insurer

**London**—At the end of the first year of business with jet aircraft operators, a London insurance firm has asked for more statistics to support its case for charging higher rates for jet aircraft. Expected early jets in 1969 had been assumed in accordance with what could be predicted from piston and turboprop experience, according to Alex Trevel, chief services of British Aviation Insurance, in a speech to the Insurance Institute of London. Record of the best piston engine aircraft showed that four out of every 100 such aircraft built were completely destroyed, in addition to a substantial period losses. Trevel said:

"Even if we do as well as this with jet aircraft, we are now dealing with values which would give us losses on the big American jets on the order of \$25 million per 100 aircraft built," he said.

If these trends continue, by the time 500 jets are delivered, there may be \$40 million, he added.

Trevel said there were already about 600 jet and 800 turboprop airplanes on order—about half the number of piston-engine transports now in use.

"We have a business in which values are going up and up and the speed of rate a going down and down," he said. Total half values of world's aircraft would now total \$5.6 billion, he added. Since each airline had an arbitrary calendar renewal date for its insurances he said, and new aircraft purchases were being made, the premium income was at risk. He said the new aircraft, and the new aircraft, were not what they needed. He said the current first year of jet business where some 60 jets had been ordered without accurate comparison getting an annual premium on those aircraft.

Hunter suggested that a half 12 months premium be paid for each aircraft from date of delivery.

Commenting specifically on the Boeing 707 and de Havilland Comet 4, Hunter said the fact that Boeing already has earned its full insurance proceeds and reached saturation figures of 13 is a double whammy for the airline industry and the aircraft itself. Although the Comet 4 had been involved in three major accidents and one had been totally destroyed in Pangloss, he noted "several encouraging features" about the accidents aircraft had but the ground at a forward speed of 160 kt without disintegrating the integrity of the fuselage and strength of the aircraft to deliver with very efficient safety devices had saved a number of lives which "undoubtedly" would have been other way last.



MODEL, complete with engine intakes, flaps and light controls undergoes low speed handling tests with the hinged leading edge dropped in 9 ft. x 7 ft. wind tunnel.



SELECTION from a study of eight light alloy half-wing models shows investigation of vortex thickness and aerodynamic wing without using DH-121 intakes.



A guided missile intercepts an attacking aircraft

at very low levels, up to great altitudes...

## ...AND BRISTOL SIDDELEY SUPPLY THE POWER

Bristol Siddeley Engines Limited produce the Thor missile. Two Thors power the missile in the Bristol Ferranti Bloodhound guided weapon system. This system forms the most effective defence against air attack at very low, up to very high altitudes. And the great flexibility and development potential of the missile means that Bloodhound will be able to intercept any attacking aircraft for many years to come.

The missile is the simplest air-breathing engine that has ever been devised and the Thor is virtually a stainless steel tube which can be lifted by two men. A thrust of over 20,000 lb at Mach 3 can be expected from a typical missile of the Thor's size.

At speeds of Mach 2.5 and upwards, the missile has a lower specific fuel consumption and a lighter weight than any other prime mover, and the higher the speed the greater its efficiency. In fact, it is the most efficient powerplant for long-range flight at high supersonic speeds within the earth's atmosphere.



**BRISTOL SIDDELEY ENGINES LIMITED**

Bristol Aero-Engines Limited, 105, International Aviation Building, Montreal 3, CANADA

POWER FOR THIS



The Bristol Siddeley Marine Proteus powers the world's fastest naval vessel, the "Hermes" class Royal Navy patrol boats built by Vickers Ltd. Three Proteus deliver a total of 11,500 hp—give them 4 knots a speed of over 50 knots. The Marine Proteus is quiet-running, flexible, reliable and holds huge reserves of power for emergencies.

AND THIS



The Bristol Siddeley Olympus high thrust turbojet powers the Avro Vulcan V bomber—gives this delta winged aircraft carrier a performance unsurpassed by any aircraft in its class. Current Olympus versions deliver 17,000 lb thrust dry—24,000 lb with boost. Even more advanced Olympus versions are rated at 33,000 lb with boost.

AND THIS



Bristol Siddeley Maybach diesel designed for a wide variety of applications, range from 150–3,000 hp. Shown is a British Railways diesel hydraulic locomotive powered by two Type 30U 600 engine, developing a total of 1,200 hp. A large number of Maybach diesel engines have been ordered by British Railways since.

## AIRLINE OBSERVER

► Five Latin American airlines are expected to announce a merger next month that would create a single international air transport system capitalised at \$35 billion. Initial meeting to discuss the plan was held in Panama last month. Second meeting, which technical aspects of the proposed merger will be discussed, will be held within two weeks in Lima, and a third and economic meeting will be held in mid-June. High costs of purchasing, operating and maintaining jet equipment were given as the reason behind the action. The five airlines involved are Avianca of Colombia, LAN of Chile, Compañía Ecuatoriana de Aviación, Corporación ABOA of Ecuador and Tropicair of Peru. Merged company would initially operate with five turbojet transports.

► Presidents of nine International Air Transport Association airlines operating between North America and Europe agreed at a special meeting in Paris to end their rate war in which IATA fares were being slashed by as much as 50% (AW Nov. 23, p. 47). Although it was expected the meeting would agree to a new common North Atlantic fares below the present level, the nine presidents agreed to maintain the present fare structure. Decision was reached at midnight of the first day of the two-day session.

► First carrier to announce rate cuts after Apr. 1 when an open-rate restriction on most international routes probably will end is South African Airways. The carrier plans to undercut the current lowest rates by 30% beginning next October when it introduces Boeing 707 turbojet transports on its routes. The airline was one of the supporters of British Overseas Airways Corp. at the International Air Transport Association traffic conference at Honolulu when the open rate restriction developed as a result of BOAC's fight for a 20% cut below current tourist fares on the Far Eastern and African routes (AW Oct. 19, p. 38).

► Airlines will launch an industry-wide program designed to expedite the exchange and disposal of excess spares and parts. Total value of such parts now on shelves is estimated at more than \$50 million.

► Lockheed Aircraft Corp. has received a purchase/lease order from Trans-American Aviation Corp. of Miami, Fla. for two Electra turboprop transports. The Trans-American Electra will be available for lease to any air carrier or to large companies that might require turbo-propelled executive transportation.

► Aeroflot plans to continue the expansion of turbojet and turboprop service to new routes this winter. Ten-1000 turbojets will be placed in service from Moscow and Leningrad to Strasbourg in the Crimea. B-48 turboprop transports will begin operating from Moscow to Yakutsk, Novosibirsk, Adakhabad and Makhovsk and from Yakutsk to Murmansk. Vostochny Almaz Airlines A-60 turboprops will be put on the Irkutsk-Yakutsk, Novosibirsk-Almaz and Khabarovsk-Magadan routes in Siberia.

► Civil Aeronautics Board last week drew charges of "transcendent ineptness" by the Aviation Security Committee of the Insouciant Airlines Association of America which waste the agency to be more mindful of the airline industry's profit needs in 1960. The committee concluded that the new Board in the Board resulting from the recent appointment of two new members was spooked new interest in the industry's earnings problems. The committee also said that Airlines Air Transport Service activities be confined to essential industry matters only.

► Trans-Canada Air Lines and British Overseas Airways Corp. have signed an agreement calling for integration of transatlantic schedules and inter-changeability of tickets. Ticket and sales offices of both companies will conduct business on behalf of each other.

► New Zealand National Airways Corp. has entered four Fokker F-27 Friendship turboprop transports and taken an option on an additional seven. Leading competitor in the New Zealand sales campaign had been the Hawker Page Dart Herald.

## SHORTLINES

► Air Transport Association estimates that U. S. local service airlines will have carried 5,217,000 passengers by Dec. 31 as compared with 4.2 million persons in 1955. The association also estimates that the 11 local carriers will post gross revenues of \$110,950,000 this year as opposed to \$94,654,000 for 1955. Other categories in the ATA estimates are passenger miles, 1,697,697,000 for 1959 as compared with 820.2 million last year, available seat miles, 3,510,712,000 this year versus 2,781.5 million in 1955. By mid-1959, local service carriers were serving 546 cities over a 42,000 mile air network.

► Alaska, Italian state airline, will begin two Douglas DC-8 turbojet flights each week from Rome to Montreal/Quebec starting Apr. 1, 1960, in competition with Canadian Pacific Airlines' two weekly Bristol Britannia turbojet flights which are scheduled to begin on May 1 over the same route.

► Allegheny Airlines will issue a single ticket to groups of two or more passengers traveling together to the same city on its routes under a new plan beginning this month.

► Federal Aviation Agency has ruled for bids to be opened on Dec. 17 for the installation of an utility system, four miles of runway and a jet parking apron 800 x 4,000 ft. at Dallas International Airport near Washington, D. C. First landing pads for helicopters also will be constructed.

► Irish Air Lines has resumed flights on its European routes following interruption of the eight-day oil workers' strike in Ireland. Transatlantic flights were not affected by the walkout with service being maintained by a relieving ship at Keflavik, Iceland, during the strike. Flights on routes from New York were fully loaded with fuel at Keflavik, flown to Dublin, landed, serviced and flown back to Keflavik, without refueling at Dublin, refueled in Ireland again and flown on to New York.

► Pan American World Airways is scheduled to begin weekly Boeing 707-320 service from the West Coast to Sydney, Australia, via Honolulu and Fiji, on Dec. 15.

► Swissair plans to begin three flights per week from Stockholm to Tokyo, based on July 1, through Swiss Aviation. Canadian turbojet transports in competition with Alitalia, which is scheduled to begin its Constellation service on a three flights per week basis in April.



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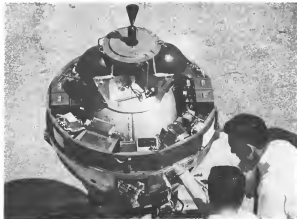


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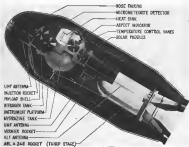
Experience in precision design and manufacture is the Bulova tradition—the Bulova capability—it has been for over 60 years. For more information write: Industrial & Defense Sales, 65-15 Woodside Avenue, Woodside 77, N.Y.





Payload that was to have been put into orbit around the moon is prepared at Cape Canaveral, Fla. Nozzle at top is a schrammel that was to help control injection angle to ensure low circular orbit. Rocket had capability of firing twice.

## Attempt to Launch Lunar-Orbiting Payload Fails

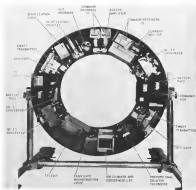


Astronaut's conception shows layout of payload when covered by plastic shroud. Solar pad also is visible. UHF antenna bracket the injection angle rocket at top.

Attempt to send a complex 373-lb payload into a low circular orbit around the moon failed due to malfunctions during the launch phase. About 150 lb. of instruments were to have scanned the lunar surface with a television-like system, measured propagation of very low frequency electromagnetic waves in ionized gas in a magnetic field, measured the moon's mass and the degree of firmness at its polar axis, measured distribution and speed of microwaves emanated on the flight, and measured density and types of substances in space. Backing payload existed but no backup for the Atlas-ble IV launching vehicle had been allowed for Atlas 204D used for the flight, which had been borrowed from Project Mercury. Simplified payload had been aimed at demonstrating considerable scientific exploration capability in spite of the weight limitation imposed by U. S. boosters. Mid-range propulsion system with capability of being fired four times, and injection rocket, which could be fired twice, would have been first test of ability to maneuver satellite. Atlas-ble was nearly 100 ft. long and weighed more than 250,000 lb. at launch.



Payload-like devices on 373-lb payload (above) was to control infrared temperature during 24-day flight (AW Sept. 7, p. 26). Tubes contained 5,500 cells for converting solar light to electrical current for recharging chemical batteries. Another gear is detailed below: overall view at right shows places where that overall payload during flight.



## 64 channels in 60"

On these two pre-engineered fully transistorized Model 850-1500P Preamplifiers appear actual size—each measures approximately 20" x 7" x 14 1/2". Six racks of eight, 64 preamplifiers take only 46" of panel space, and a blower unit another 4". Necessary power and blower installation is provided by a completely transistorized Model 850-600P Power Supply that mounts at the rear of each 8-preamplifier unit, so that no additional panel space is required.

## unusual capabilities and stability

### INPUT CHARACTERISTICS

Input-circuit impedance, floating, isolated from output, can be grounded. Input impedance 200,000 ohms min. (Preamplifier also available at wide range with input attenuator with gains of 18, 30, 50 and 100 and constant gain control to match any intermediate scaling.)

### BANDWIDTH

DC to 70 cps 1—3 dB.

### RISE TIME

25 ns to 50 95% of steady state value.

### OUTPUT CHARACTERISTICS

Powering independent of input can be selected.

Capacitance: a)  $V$  across 300 ohms, DG to 75 ohms  
b)  $V$  across 300 ohms, DG to output

Output impedance 100 ohms. Output is across 300 ohm internal load, shunted by internal 4 mil cap. output. Part or all of that not shown and capacitance can be supplied externally, in any combination to suit your application.

### LINEARITY

+0.5% of full scale output (3 volts)

### DRIVE

200-16 mv load for 3 volt output. Preamplifier with gain of 1000:1 may load for 3 volt output; also available on special order. Cost stability +0.1% for each of 24 hours.

### IMPEDANCE REJECTION RATIO

120 dB at 10 cps, 140 dB at DC, with 2000 ohm impedance to source.

### IMPEDANCE TOLERANCE

25% VDC, 25% VAC

### NOISE

2 mv peak to peak referred to input (measured with DC to 100 cps). Noise also usable for full scale signal; not to exceed +0.5% of signal (measured with band reject to 100 cps).

### DRIFT

+0.2 mv referred to input, at constant ambient temperature after 30 minutes warm up. Input drift temperature coefficient +0.2 mv/°C, max.

### OVERLOAD RECOVERY

Preamplifier recovers from fully blocked condition within 30 milliseconds after removal of signal. 10 years of signal at input with no damage preamplifier.

### POWER REQUIREMENTS

Each Preamplifier requires 2.5 watts. Model 850-600P Power Supply handles up to eight Preamplifiers.

## \$462.50 per channel, complete

Each Model 850-1500P Preamplifier costs \$460, each Power Supply for every two preamplifiers, \$200. Consider the substantial savings over equipment with comparable specifications—about seventy per cent!—in multiplying the number of channels you require. All prices are F.O.B. Watillon, Mass., within continental U.S.A.



What distinguishes this data preamplifier from others is not its specifications alone—but the performance of the preamplifier with high reliability, precision and stability. Together, they make the Sanborn.

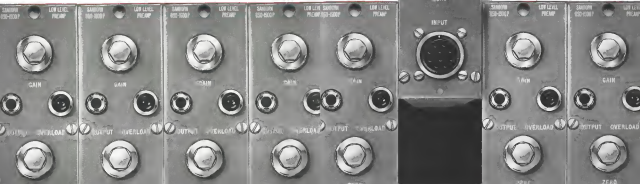
Model 850-1500P the logical choice for data processing systems in which tens or hundreds of channels of information must be handled.

Completely transistorized, the 850-1500P is designed for amplifying low level inputs such as thermocouples, strain gauges and resistance bridge outputs. Typical outputs include digital voltages, logic readouts, scopes and other modern devices.

Complete engineering data and application assistance is available from Sanborn Company. Contact your nearest Sanborn Industrial Sales Engineering Representative, or write the main office in Watillon, Mass.

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COMPANY**  
INDUSTRIAL DIVISION  
175 Wyman St., Watillon 24, Mass.

# New Data Preamplifier model 850 -1500P



## Minuteman Tests Yield Silo Design Data

Edwards AFB, Calif.—Series of underground silo tests of the full-scale model solid-propellant Minuteman ICBM now being pushed here is increasing interest in experimental launch phenomena which promises to let the groundwork for advanced followup testing at Patrick AFB Fla. and Vandenberg AFB Calif.

Underground silo tests at Edwards are planned in two installments—two holes about 55 ft deep and 16 ft in diameter over all (ENR Aug. 3 p. 93). First group of firings in the series of tests at Edwards is being conducted with a "landlord" configuration, composed of dummy second and third stages coupled to a live first stage which is partially loaded to give a limited burning time. Second group of firings in the series at Edwards will use lightweight light cones more closely approximating the real configuration of the missile to give results that will closely approach operational conditions.

The full series of Edwards tests should provide enough experimental data for analysis and engineering analysis to design full-scale scientific and development installations for advanced Minuteman testing with a configuration very close in all respects to the projected operational missile. It is held that Patrick will be chosen as the site for these facilities because of all the advantages the base itself offers as a test area as well as the wide expanse of the Atlantic Ocean for actual test firings.

Indications are that Patrick is preparing for these tests must, two concerns are being met, there now, strengthening the type of hole that Minuteman will require.

**Firing Control**  
A launch control center for these Minuteman silo facilities would not be required since Patrick already has control blockhouses for its continuing ballistic missile test program. Minuteman control could easily be tied into these existing facilities.

Considering the present state of the Minuteman development program and the number of basic problems that must still be solved before advanced research and development testing is handled into the program, tests at the Patrick complex could be at least a year away.

After the research and development testing at Patrick, an operational development phase for Minuteman probably will follow. Since Minuteman will be a Strategic Air Command weapon, this operational development phase about centers would be conducted at Vandenberg AFB, the site of SAC's ballistic missile training and operational development program.

If the operational development phase is conducted at Vandenberg, chances are that it will not be with a complete outfit with components that have not been evaluated previously. This means that support equipment for the missile would have been proved out elsewhere and the complete system assembled for checkout at Vandenberg as a logical operational proving site.

Meanwhile as the Edwards silo launch development program for Minuteman, both silos are being used to crown that the feasibility of launch will run on schedule and should one of the silos be put out of commission, another will be available as a backup facility.

The last three shots in the initial series at Edwards AFB already have been fired successfully. Patent schedule anticipates that the series of tests



**Polaris System Tested on Nuclear Submarine**

Minuteman-like towers of water sprays from one of 36 Polaris missiles taken on nuclear submarine George Washington during firing tests at Groton, Conn. Sprays and water are seen rising from the top of the missile at right. Shot was occurred for later tests.

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Compact, rugged and safe, the Bohanan Rotary Actuator operates a simple but effective web strap arrangement. When fired, the rotary actuator winds the webbing fast between the head rest and the bucket lip. The man is positively ejected from the seat and an automatic parachute mechanism is activated.

By saving pilots' lives, the Bohanan Rotary Actuator plays a vital role in preserving our National Security.

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at Edwards will run until April or May, 1968.

One of the major problems facing Air Research and Development Command's Ballistic Missile Division, which has experience of the Minuteman program, was demonstration of the least expensive, but highly efficient, configuration of the side launcher. Economy of the side design is a critical factor in the deployment of the Minuteman weapon system, because of the large number of sites which probably will be used to create a reasonable factor of survivability for retaliation after any surprise attack. No specifics on the number of side launchers planned for the Minuteman system have been released, but the general estimate now under consideration for Minuteman's operational strength ranges from the middle hundreds to the high thousands.

## Silo Types

Three general types of silo schemes for Minuteman have been under consideration.

• **U-tube.** In this scheme, the missile would be deployed in one of the arms of the U, with the exhaust directed around the head of the U and up through the other arm to the surface.

• **Concrete bore.** This proposal uses a central hole with an annular exhaust space surrounding it to lead the gas to the surface. In effect, it is similar to the U-tube except that the exhaust gas passage is annular instead of down and up through the second U-tube arm.

• **Simple silo.** This is a simple blind hole, with exhaust gases (emanating from the hole directly) up the side of the missile. This scheme would use a fence deflector—a configuration similar to the center portion of a simple headshold, except for its shape.

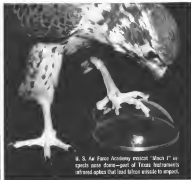
These deflector also could be used with the concrete bore silo configuration.

Except for the U-tube type of silo, no previous data was available on silo environmental phenomena.

## Simple Silo

The simple silo was the most difficult configuration to build, but had the greatest chance of successful operation. It was decided to build the silo scheme first and if it did not prove feasible, resort to the U-tube or concrete bore approach as an alternate.

Thus far, tests in the Edwards also have indicated no reason to doubt the feasibility of the simple silo scheme, or even to consider a backup effort with either a U-tube or concrete bore silo. In the full-scale model tests, from the Edwards silo, the waste is returned to the pump by a wire cable which takes the form of a tube to return the waste so that it will not reach more than a few hundred feet above ground.



A. S. Ar Force Academy missile "Mach 1" is tested into down-pull of Texas Instruments infrared optics that had before missile to impact.

## INFRARED SPECS FOR THE FALCON

**Force Missile**—as deadly as its feathered namesake—is guided to the kill by Texas Instruments infrared optics. Unlike nature's Falcon, this Air Force missile has only the combative instinct, attack accuracy, and destructive impact that are built into it at the design and manufacturing levels.

Imparting these methods to miniature systems is the business of TI optics engineers and craftsmen. Leading designers and producers of silicon, germanium, quartz, and other optics for infrared applications, the TI optics team has fingertip familiarity with unusual materials suited to specific portions of the spectrum. In one of the nation's best equipped facilities, TI optics specialists grind, polish and coat components with accuracy that exceeds the most from even the weakest infrared signal. This experience can work for you. Whatever your needs... prism, lenses, windows... TI's full-time engineering service, modern computers, and complete optics facility can meet your requirements from design to delivery. For detailed information on any phase of precision optics technology, contact SERVICE ENGINEERING.

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Thermostats tested at 100G shock, vibration 100's to 2,000 cycles per second without malfunction. Tests have been run a total of over 2 million cycles, and calibration remained within  $\pm 1^\circ$  of original setting.

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level upon firing of its partially loaded first stage.

Partially loaded first stage incorporates a thin core of live propellant inside a hollow case. The failure of the material between the case and the core is airtight. The propellant burns its full length simultaneously, and the discharge of the burning case provides sufficient gas to propel the full scale model out of the hole and then give it some altitude.

Race engineers originally aimed with regard to establishing the alo diameter to accommodate burning phenomena and the inside diameter which is fixed.

It would be advantageous to use as small a diameter as possible for the operational life because excavation costs would be less, weight and cost of an operational alo door would be less, and the alo itself would be easier to handle.

Previous studies indicated that the alo diameter should be between 12 and 16 ft. for the full scale missile. But, in effect, this actually was an unknown stage, which the Edwards tests attempted to resolve.

The actual holes prepared for the Edwards tests are considerably larger (26 ft. in diameter) in order to provide access to, distance and strain to the alo causes, also to allow removal of the causes for replacement with another to give a hole of a different diameter.

Solo holes were made about 51 ft. deep to provide a suitable distance between the missile exhaust nozzle and the flame diameter at the bottom of the alo. This distance was a critical dimension in that it was one of the unknowns which had to be evaluated. To provide an easy method of varying this distance it was decided to have rods in additional section of alo causes to fit on top of the alo hole prior to that the alo section would penetrate above the top of the alo to provide the extra alo depth.

In truth to date, it has not been necessary to use this additional section, thus indicating that the alo hole had true distance as originally estimated has been sufficient.

First full-scale model firing from an Edwards silo utilized a 16 ft. custom diameter.

Results of that test were so favorable that the switch to standard size was made to a 12 ft. diameter configuration for the successive firings and the next two firings—second and third in the series—with the 12 ft. diameter opening have been entirely successful.

Throughout the same data is obtained in the recovery firings, but readings are taken at different locations along the missile and alo rods, also using different instrument frequency responses and waveforms.

Already obtained are a full set of



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### Martin B-57 Carries B-57 Nose Section

Martin B-57 has been modified as forward section to carry the nose and part of the fuselage section of a B-57 as defense missile for tests at Eglin AFB, Fla. Hybrid plane-wings will check out capacity of Eagle Golf Test Range to handle light jets of the 400-ton range B-57, particularly the capability of the range telescoping system and zero-ground interception from the missile package.

data on pressure, temperature, acoustical environmental factors, vibration and shock durability.

So materials are not a consideration in this work to date.

However, results obtained in the test program will indicate materials that might be used for also design criteria—both for the future test program and

the altitude operational configuration.

For the series of flights in the Edwards area, Boeing Airplane Co., the assembly and test contractor, is conducting the tests under the Ballistic Missile Division's field office management.

Air Force and Boeing technical personnel did not go directly to the full

scale model Minuteman tests. A number of preliminary investigations were conducted.

• In first trials, the Air Force Flight Test Center personnel at Edwards established a scale-up—essentially a steel tube—in April, 1958, to determine that the simple tile configuration would not be disastrous in a firing (AVW Jan. 19, p. 58). A home-made nozzle test device was constructed which simulated realistic throat-to-nose ratio for Minuteman, but no simulation of flame temperatures or chamber pressure was attempted. A number of subcritical test firings have been conducted with this rig.

• Next step, begun in December, 1958, was to establish a 1/10th scale cold flow rig—a simple arrangement of a nozzle and nozzle, with compressed gas introduced through a string at the front end of the nozzle. With that simple scale static rig, essentially a venturi arrangement, about 2,000 runs were made, varying the test parameters such as nozzle configuration, nozzle diameter and exit angle. Data obtained included aerodynamic forces and moments on the nozzle, which helped to determine missile stability. Also obtained was data on flame deflector phenomena.

• Hot flow experiments were conducted at Edwards AFB in September, 1958, by Air Force Flight Test Center personnel. Approximately 150 runs were made, using a modified 275-4 aircraft rocket. These tests produced qualitative information on pressure, flame, deflector shapes, as well as data on loadback heating on the Minuteman airframe.

• More advanced supplementary experiments were conducted in a 1/10th-

scale hot flow rig. These were conducted at Boeing's plant and utilized a small rocket engine in a static arrangement.

Approximately 150 runs were made with this rig, producing additional information on aerodynamic forces and moments.

### Heat Data

Also obtained were heat transfer rate data (not attainable with a cold flow rig) and acoustic data.

• Next experiment, also using a simple tile configuration, employed a one-third scale static rig at Edwards AFB, with tests conducted by Air Force Flight Test Center personnel. First firing with this arrangement was in February, 1959. The also was mounted horizontally for convenience of operation. Its operation continued through April 1959 and, after four tests had been run, Boeing Minuteman assembly and test personnel took over the previous experiments which had been run by Air Force Flight Test Center staffers. To date, approximately 15 runs have been made with the one-third scale model static test rig.

### Experimental Opportunities

This rig actually provided the first experimental opportunities to:

- Conduct experiments on a scale sufficiently large to explore the nature of the full-scale problems.
- Confirm results of the 1/10th scale tests as well as flame deflector phenomena.
- Obtainable acoustical data essentially representative of Minuteman tile environment.

All these preliminary scale experiments established parameters of subjects and proved rules for the full-scale tests at Edwards which followed.



### Soviet Pilot in Altitude Chamber

Soviet high altitude test chamber to study physiological reactions of pilots for possible space use in an operation at Moscow. Above, Zoya Amosova, space laboratory worker, checks various instruments, sets chart to record reactions. Below, Gennadiy Mikhalov, a test pilot, is shown in the chamber wearing pressure suit, which attaches strap like fit on legs.



### Radioplane RP-76 Rocket-Powered Target

Radioplane RP-76 solid rocket-powered target missile will be used in U. S. Army Nike Ajax and Hercules high altitude training missions. RP-76, being built by Radioplane under a \$7.5 million contract, is radio-controlled and is recoverable by parachute. Airframe is mostly laminated glass fiber plastic. Target has reached Mark 54.



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## New Business Search

Thus, ending new business is regarded by the company as an acute serious near term problem. It recognizes the dangers of being too heavily in one single market program, though the market for the F-105 at the moment looks lean through 1982, based on orders for 525 airplanes. This does not include another 400 which might be ordered for Tactical Air Command or foreign orders.

Laboratory for Electronics is working in several directions for broadening its operations:

- **Foreign business.** The company has negotiated with Polaris and also with companies in France and Italy for co-operation business. This would include not only display systems for air forces in order for F-105s and possibly some gear for the German F-104s, but also construction business in the European Common Market.
- **Merger.** Though a recent proposal that it merge with Semiconductors, Inc., was turned down by the company's

## FINANCIAL

# Avionic Makers Fight to Maintain Growth

New York—Rapid growth by many avionic companies has brought with it related problems, such as demands on management to keep the rate rising in the competitive drive to take profitable development contracts in the hope of gaining new production business.

A typical one is parent Laboratories for Electronics of Boston. This company shared recent hardships because of three development programs on which more development was required than originally estimated: a radar-horizon radar system and SPAR, a precision approach radar system, which cost the company \$14 million; and Dana, a large radar computer system.

In 1995, the company lost \$544,000 and new management was brought in. In its 1979 fiscal year, ended Apr. 30, the company, which had doubled its 1978 volume, reaching a total of \$28,410 and it earned \$575,000 after taxes. It was able to cut its accumulated deficit from \$718,007 in 1975 to \$140,061.

Most of the rapid rise in volume is due to the company's APN-105 and APN-130 display navigation systems for the Republic F-105 Thunderbolt fighter bomber. Of the company's 1979 volume, a contract for 110 of these systems accounted for \$11,900,000 and of the company's fiscal year end backlog of \$36,290,000, two display production contracts accounted for \$29,300,000.



LABORATORY FOR ELECTRONICS display navigation system in the Republic F-105 is run through ground test in the aircraft.

board, a merger preferably with a West Coast company with electro-mechanical capabilities is still being actively sought. The Semiconductors step fell through when its earnings failed to reach estimates in the negotiations.

• **New products.** The company has 500 of its 1,200 employees engaged in research and development. It is still in the market for new products. Its Computer Products Division volume was \$1.3 million in Fiscal 1979 and supplies a magnetic storage drum to RCA for a data processing system. Under development is a storage disk using ferro-magnetic thin films which can have growth, increased storage capacity. Another device the company is developing is a Mercurian tube, a

vacuum tube for displaying usually the data stored in data processing systems. A report in the investment firm of Pratt, Winkler, Jackson & Cunniff estimates the computer operation will bring the company \$1 million this fiscal year and perhaps \$25 million in five years. Based on five year forecasts of total volume of \$750 million, this volume will contribute 75% of sales and more than 50% of profits.

## Maintaining Growth

Herb W. Harding, who was brought in as president in 1976, and that maintains the sales growth curve at a low importance to the company's future. Even a flattening of the curve can have adverse effect, he pointed out. Among

either things, a steady rising curve is registering in attracting and holding the needed people this company must have to compete.

He estimates sales for this fiscal year will reach \$35 million and earnings somewhere between \$500,000 and \$1 million.

An important financial factor in the company's life is David Rockefeller and the company's has only a minor stake in a large individual investor, and not in connection with the funds. A substantial holder of the company's common stock, he liquid himself before when the deficit appeared and to safeguard his investment found it necessary to put another \$100,000 into the company's 6% convertible preferred stock, to keep the company operating in 1958.

Besides cutting out several important able lines of investments, including oil companies, the new management has consolidated the company into one plant in Boston instead of the five it previously used. The plant is leased at a cost of \$180,000 annually, the lease charged into the company's stock is a large required capital outlay.

Operational units have been strongly accelerated without obtaining more capital. Not only does this act as a safe guard against the several badlines in times of contracting volume, but the price to pull back work into the house, but it has other advantages.

In the company's two decades one factor mentioned earlier there is also at least \$10 million in spare finance that will be added. These fringe benefits are held valuable significantly. Handling points out.

The company has had some delivery and scheduling problems and a reliability group was set up as a result. It found that 50% of its scheduling problems on the delivery system were simple data errors at different points, primarily a production line problem, not design.

## New Offerings

Telephone Manufacturing Corp., Asheville, N. Y., engaged in the manufacture and sale of telephoning equipment for guided missiles and residential telephoning systems and connected television equipment. Offering is \$750,000 of 6% convertible debentures, due 1969 (convertible into shares of the company's Class A stock, 10 cents per share), for public sale at a price of 100% of par value. Underwriters have agreed to purchase the company's Class A stock purchase warrants, convertible for a period of five years from date of issue, to purchase an aggregate of 10,000 shares. Proceeds will be used to retire bank notes, to pay the balance of the purchase price for 70% of the issued and outstanding capital stock of the Harmanbrand

Manufacturing Co., Inc., for advances to Universal Television Products Corp. for expansion of manufacturing facilities and the purchase of equipment and other corporate expenses.

Copperhead Steel Co., Pittsburgh, Pa., engaged in the manufacture of electric cable for various industries and tubing and tube assemblies for aviation support equipment. Offering is \$8,000,000 of convertible debentures, due 1973, for public sale. Proceeds will be used to pay short term notes, balance will be added to the company's general funds and used, together with other funds, for the expansion and improvement of the company's manufacturing facilities.

Tennessee Electric Corp., Watfield, Mo., principal business the development, manufacture and sale of semiconductor products. Offering is a secondary, with 1,000,000 shares of outstanding common stock, involved, price and terms to be supplied by underwriter. Selling stockholders are David Bakula, president, and Len Bakula, board chairman and treasurer, both men an aggregate of 66.6% of the company's outstanding stock, each is selling 500,000 shares.

Midwest Airlines, Office, N. Y. Offering is \$2,500,000 of 6% convertible debentures, due 1974, \$1,917,500 to be offered in exchange for a life amount of the company's outstanding 14% convertible debentures, due 1966, the remainder, plus any interest on the exchange offer, to be offered for public sale. Proceeds will be used to pay subordinated (5000,250), the balance to be added to the company's general funds. These shares, together with the exchange offer, are expected to be secured, will be used to repay the company's account with railroads, to improve the air conditioning system in its Boeing aircraft, and its additional working capital and other corporate purposes. Proceeds from the sale of any portion of the \$1,917,500 of debentures not taken up in the exchange offer will be used, together with other funds, to redeem the remaining outstanding 14% debentures (AW June 6, p. 36).

United Control Corp., Seattle, Wash., principal business the design, manufacture and sale of control systems, electronic equipment and accessories for defense and commercial aircraft, missiles, space vehicles, and industrial units. Offering is \$2,500,000 principal amount of convertible debentures, due 1974, to be offered for public sale. Proceeds will be added to the company's general funds and will be used in the proposed plant construc-

tion program, and for increased research and development activities.

Bowman Instrument Corp., Fort Wayne, Ind., principal business the design and manufacture of electro-mechanical apparatus for aircraft and missiles. Offering is 70,000 shares of common stock, no par value, to be offered for public sale, 45,000 shares are being offered by the company and 25,000 shares by stockholders. Proceeds will be added to the company's general funds, a portion of the proceeds will be used to retire short-term loans, in the amount of \$200,000, incurred for working capital purposes.

Amtek Corp., Boston, Mass., principal business the design, development and manufacture of high speed printers for use in association with computers and electronic data processing equipment on an outlease. Offering is (1) \$2,250,000 of subordinated debentures, due 1974, with warrants attached to purchase 45,000 shares of common stock, \$1 par value, (2) 90,000 shares of common stock, \$1 par value, debentures and stock, to be offered in units consisting of 550 principal amount of debentures (with attached warrant to purchase one share of common stock) and two shares of common stock. Proceeds will be used to pay in full principal amount, plus accrued interest, of outstanding serial notes, to reduce and pay accumulated dividends on the 2,400 outstanding shares of cumulative preferred stock, to pay a dividend, such as Anderson-Nichols & Co., to be used for machinery and equipment, and the balance for general corporate purposes.

## Acquisitions And Mergers

Hi-Cool Corp., Danbury, Conn., is offering 157,500 shares of its common stock without par value. In the holders of outstanding shares of the capital stock, \$10 par value, of Corp. Hi-Cool. The holders of 95% of the outstanding Corp. Hi-Cool stock have entered into an agreement with Hi-Cool to exchange their holdings of 10,055 shares of Hi-Cool stock for 157,500 shares of Hi-Cool's common stock. The agreement contains a representation that, except for 31,488 of the 157,500 shares, the Corp. Hi-Cool stockholders have no present intention of selling any of the shares of Hi-Cool that they receive pursuant to the proposed exchange. In a period of six months following the exchange, all in part of the shares of Hi-Cool stock may be sold from time to time in any part of the exchange. Corp. Hi-Cool stockholders at present current at the time of sale, Hi-Cool stock will secure no part of the proceeds of any of such sales.

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Launching Control System Design

- AIR FORCE FLIGHT TEST CENTER  
Photographic Instrumentation Timing System Study  
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Design and Construction of Timing and Control Systems for Timing System  
Design and Development of Central Time Code Generator
- NAVAL AIR FORCE TEST CENTER  
Development of Test Vehicle Timing and Control System  
RONALD SANDERSON AIR FORCE  
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SARF Timing System  
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## Alloyd Explores Gyro Cleaning Technique

By James A. Fieser

Cambridge, Mass.—Substantial increases in the life of bearings for the highly precise gyroscopes in inertial guidance systems may result from a research program now under way at the Allied Corp. in collaboration with Massachusetts Institute of Technology's Instrumentation Laboratory. Alloyd, a company set up in personnel from the MIT faculty, has been studying the problem of precision bearing operation since 1946 and presently holds contracts totaling about \$400,000 from the Navy and Air Force.

### Adhesive Particles

The company believes that its has demonstrated conclusively that a prime cause for the failure problem can be countered with gyroscopes in continuous use by abrasive particles of the girth process. Bearings used in that it should be possible through proper cleaning techniques to markedly increase the life expectancy of these bearings. Additionally, it should become possible to run these bearings at higher speeds than now materials and speeds with will be inherent for longer periods of time than at present. This would improve

gyro performance without adding the complexities or a change to electrostatic or air-supported bearing systems.

The method most commonly used at present to examine most bearings is to inspect by eye and foreign matter is usual inspection by means of a stereomicroscope at magnification of 20 to 40 diameters with a standard white light source. In its investigation Alloyd examined a series of failed bearings supplied by MIT's Instrumentation Laboratory. In attempting to improve the resolution of this inspection procedure used on bearing surfaces, various microscope techniques were tried, such as dark field, interference microscope, and the use of polarized light.

Polarized light microscope proved to be the technique which provided the most useful information. Using polarized light, it was found that particles on the surface of the bearing—which were transparent and difficult to see under white light—light sources showed up distinctly. The light scattering properties of these particles indicate they must have a double index of refraction and were also be transparent or translucent. Later work indicated that these particles were either embedded in the raceways and balls or

held on by electrostatic attraction.

Comparison of these particles with materials used in finishing operations during manufacture of the bearings indicated that they must be grinding or lapping compounds. Samples of the compounds normally used in finishing of these precision bearings were obtained and the size, shape, and color of these materials were found to coincide with those of the particles found in the bearings. To determine the bearing to manufacture rather than assembly, new bearings made by different manufacturers and of a variety of sizes were obtained and examined. Particles were found in all of the bearings inspected.

The technique of using polarized light has proved so sensitive that with practice it is possible to tell whether the finishing compounds are quartz, kyanite or diamond. After studies that in view of the size and quantity of the particles found it could be considered surprising that they have not been seen earlier. The company points out, however, that these particles are obvious only under polarized light, under white light conditions they are completely invisible.

### Types of Failures

Gyro-bearing failure is evidenced in several forms, such as:

- Friction behavior caused by dirt contamination
- Failure through distortion of raceways
- Slow but marked increase in friction level with time, leading to sufficiently increased running torques so that in the extreme the gyro motor cannot be kept at underspeed or speed.

Failure of materials within the bearing is obviously serious, as is failure resulting from "racy" contamination within the bearing. These defects, however, can be detected through the use of a slow-speed dynamometer which measures vibrations transmitted from a slowly spinning bearing, and from the traces on a chart it is possible to pick out defects in gaskets, and lubrication and dirt contamination.

It is the friction increase type of bearing failure which is the most costly and which presents the greatest problem because it may take place over a long period of time. This form of failure as evidenced by a delayed increase in running torque is termed a lubrication failure, and bearings which

were examined after such a failure invariably showed a heavy layer of material deposited within the raceways.

With the discovery that ground surfaces can be contaminated with abrasive materials, Alloyd theorized that the reason of forming the varnish which causes the lubrication failure is the polymerization of the lubricant. It has been known for some time that a clean, or oxide-free, metal surface can act as an excellent catalyst for the polymerization of oils—and the action of abrasive particles in the raceways is to make good with clean surface. The secondary solution to this problem would then be to remove the abrasive contamination.

### Cleaning Tests

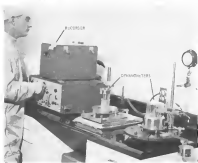
Alloyd, working in cooperation with members of MIT's Instrumentation Laboratory, has conducted a series of tests covering all kinds of cleaning operations. A large number of lubricants were tried either alone or in an ultrasonic cleaner, but none was entirely successful. One reason was that while most of the particles were actually embedded in the steel, others were held to the surface by electrostatic attraction. Wiping methods moved them from one place to another on the bearing.

The only effective cleaning technique uncovered to date has been the application of a weak etch by means of a 1% nitric solution. Recognizing that there might be some detrimental effect to the surface of the bearing from this kind of etch, a series of tests is now being performed at MIT on bearings cleaned with this method. These tests are aimed at determining if the long life expected from "clean" bearings can in fact be obtained in actual use. Preliminary results indicate bearing life will probably be substantially extended.

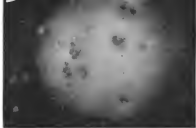
### Contamination Sources

A corollary to this work was the discovery that other sources can contribute to the contamination material besides the compounds used in the lapping and finishing processes. For example, it was discovered that since the plunger of a hypodermic needle assembly generally is lapped in place with a grinding compound, using a hypodermic needle to oil a bearing leads directly to contamination by abrasive material.

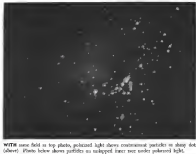
Another source of contamination is the lubricant itself. It is common practice to protect the lubricant used in these gyros through ceramic filters, sometimes in series, at three or four times. Alloyd uncovered the fact that a relatively large supply of lubricant which had been filtered in this manner was thoroughly contaminated with abrasive material coming from the filters themselves.



BEARINGS are examined in the Alloyd investigation by means of the experimental set-up shown above. Slow speed dynamometer tips the bearing (right) and the sensor output is amplified and displayed on the strip-chart recorder at the left.



AT 200 X magnification, particles left bearing show angles from finishing operations.



WITH same field as top photo, polarized light shows contaminant particles in sharp dots (above). Photo below shows particles as halftoned lines over under polarized light.

## Puerto Rico Radar Construction Set

Itasca, N. Y.—Insulation effects of ballistic missile travel through the upper atmosphere and radio astronomy studies will be conducted by Cornell University with a 1,300 ft. diameter radar facility in Puerto Rico.

The \$4.5 million radar facility, to be financed by the Advanced Research Projects Agency (ARPA) Nos. 16, p. 115), is expected to be fully operational within two years from the time construction begins on February 1, 1966. Test hearings are now in progress by the Arms Corps of Engineers at the site, a natural bowl of coral limestone.

The fixed radar antenna will be a 1,300 ft. diameter parabolic dish with a 600 ft. high tripod supporting the feed antenna. The stationary antenna will be able to swing its beam only 20 deg. from the vertical, affording a beam sweep of 40 deg. Despite the limited beam sweep, the location of the installation at Puerto Rico provides an equatorial latitude (18 deg. N.) for access to the solar system and to the Atlantic Missile Range.

Peak power of the radar will be 2.5 mw. and the transmitting frequency will be from 420 to 940 mc. The low frequency, long wave length signal will not provide the resolution of the U. S. Navy Radio Research Station at Sugar Creek, W. Va., which will be capable of operating at much higher frequencies. Nor will the fixed radar facility be of value for space vehicle tracking.

Cornell has established a Radio-Physics and Space Research Center which will operate the largest radar as the ARPA contract. During the winter will be Prof. Thomas Gold, a British cosmological physicist for his work with Herman Bondi on the theory of continuous creation of matter.

The radar will measure electron density and electron temperature at different heights and times in the atmosphere.



## Soviet Radio Telescope in Armenia

Photograph shows part of what appears to be a large lattice array which is one portion of the largest radio telescope known to exist in the Soviet Union. Telescope is located near Yerevan, in Soviet Armenia. Fixed radio telescopes such as this observe the earth's rotation to scan a section of sky along the equatorial plane, and can employ astronomical techniques to measure velocities.

spoke. Additionally, it can measure ionization and detect transient streams of ionized-gaseous particles from outer space in connection with the phenomenon, and replace the existence of ring current.

The installation is believed capable of receiving radar echoes from the moon, Venus, Mars, Mercury, the sun and possibly Jupiter. Gold asserted that there may be a relatively high density of atmosphere before visibility occurs on the surface of Jupiter. If no signal is obtained, scientists will know that Jupiter is shrouded in a deep atmosphere that disperses radio wave's strength.

Jupiter, at its closest point, is about 600 million mi. from earth. The current maximum distance that a radio echo has been received is the Jovian Ring, England, radio house off Venus at a distance of 10 million mi.



Ultra-High-Speed Computer—Digital computers that operate at computing speeds of 1,000 cps. may be achieved in the next decade using magnetic phase-locked oscillators in the logic computing element, according to C. B.



## He put a new twist in an old trick

The problem was to take a 3"x6"x 3-foot piece of wave guide tubing made of .005-inch thick aluminum and to twist one end 90° to the other without buckling or stretching any part of it...as that's even action taken anywhere along its length remained a perfect rectangle.

The standard solution for a problem like this: Support the tube internally with a solder-like substance that's melted in, sealed, heated out after twisting. It won't work here because the mass of the substance is too great.

Here's how this AMF production engineer found the answer. First, he visualized the concept that, in any symmetrical twist, the center axis never moves. Then he applied the concept by shimming a metal rod through the center of 200 rectangular slits, inserted them in the tube, cushioned them with the same solder-like substance. Jaws clamp on either end. One of these rotates slowly (twisting time: over 2 minutes) giving the metal time to flow. The result: Perfect twists, every time.

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## Burroughs Wins ALRI

Burroughs Corp. was Air Force contract for Airborne Long-Range Inert (ALRI) contract (AW No. 7, p. 21) which, in the first stage, will total about \$15 million and will run 42 months.

ALRI is a radio station located in a Lockheed RC-121 reconnaissance aircraft which will provide tactical extension of the SAGE system. Burroughs has previously been awarded approximately \$124 million in SAGE contracts.

About 50-60% of Burroughs' work on the ALRI project will be subcontracted, including outfitting of aircraft portions and more parts of communication and navigation equipment.



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ing offset paper masters—make copies on plain, uncoated paper in translucent red-ink for photo-type reproduction.

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# HALOID XEROX



### Plastic Radar Reflector for Tortor

Plastic radar reflector being assembled at Republic Aviation Corp. plant in Farmingdale, N. Y., will be used on Vought single engine on U. S. Navy ships. Reflector is 1 ft in diameter, weighs 324 lb., and can withstand shock load of \$50,000 lb.

Herring, Radio Corporation of America. RCA is investigating, under Navy Bureau of Ships sponsorship, the feasibility in which the digital "1" or "0" is represented by the phase of the carrier signal.

So far, RCA has performed single computer functions at a 100-mc. rate, and improved design outlines have been outlined at 250 mc., according to Herring. RCA uses gated current wave guide and a special variable-current junction diode for its switches. Although operation of microwave computers poses new computer design problems, it has certain advantages in addition to speed. For example, signals can be modulated in precise structures to perform certain logic operations, such as inversion of phase, except by 180 deg. delay of the carrier. Hybrid ring and ferrite isolation can be used to give information channels which is not possible in basic two-terminal negative resistance amplifiers, Herring says.

Navigation. AM Spooler—Counter-measures system designed to detect presence of enemy low-frequency navigation system indicators, rapidly analyze its characteristics and then transmit jamming or deception signals, is being developed for Army Signal Corps by Electronics Repts. & Photographic Corporation's Government Electronics Division.

High Temperature Thermometer—Fluorescent resistance thermometer, for

put at rate of 120 samples per second. Output is transmitted as parallel digital pulses with a parity check. New device provides conversion accurate to within 0.25%, or to within 0.1% as an optional feature, over temperature range of 0 to 750.

Dielectric Aeronautics—Digest of Literature on Dielectrics, Volume 12, published by National Academy of Sciences National Research Council, is now available from the Printing & Publishing Office, National Academy of Sciences, 2101 Constitution Ave. N. W., Washington 25, D. C. Price is \$5.00.

Telemetry Magnetics, Inc., Los Angeles, has been awarded a contract to develop airborne digital programs for Project Vega. The \$400,000 contract covers development and installation of the airborne units plus ground-based checkout system.

Signed on the Dotted Line—Major contract awards recently announced by various manufacturers include the following:

Melpar will develop and fabricate two new digital speech bandwidth compressors, ordered for USAF's Wright Air Development Center under \$550,800 contract.

Stromberg-Carlson Division of General Dynamics Corp. will develop completely transformed single add-on communication system for Navy Bureau of Ships under a \$13.2 million contract. Equipment will be used for ship-to-ship and ship-to-shore communications.

North American's Astronautics Division will design, build and flight test a fully automatic altimeter landing system, including final approach, touchdown



### SAGE Antenna at Alabama Site

At Fort AN/SPS-15 much radar at Thuleville Army Control and Warning Site, Ala., was developed by Sperry Gyroscopic Co. and is part of SAGE network. Tower is 55 ft. high and antenna weighs nearly 70 tons. Facility is self-contained.



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to do its job

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are in  
the right  
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### Beryllium Ball Used in Gyroscope

Ball of beryllium, a key part in a new gyroscope being developed by Minneapolis-Henrywell, is designed to spin at high speeds while held in position by electrical forces. It then will spin without being slowed by friction.

and runway landing roll, under \$422,000 contract from Wright Air Development Center's Flight Control Laboratory. After Air Force tests the AN/APN-114 (XA-1) motion will be delivered to Federal Aviation Agency in Atlantic City, N. J., for evaluation of its safety on the Aeronautics system, and Aeronautics Week, Oct. 5, p. 113.

• National Cash Register Co., Electronic Division, Holliston, Calif., will continue its study of superlat magnetic roll switching and storage, its units under \$70,000 contract awarded by Air Force Cambridge Research Center. The magnetic roll, which operates approximately 5015 in its data store, has exhibited switching speeds as well as 4 million microseconds, company says.

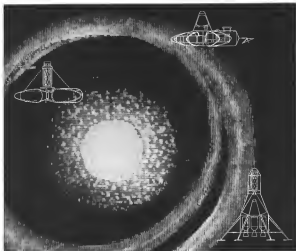
• Bendix Aviation International Division reports a contract for study and loan dollars for aircraft support to be used on West German Air Force aircraft. Equipment to be built by Teleplex-Posner and Bendix Radio, in-

cludes transmission navigation unit, radio slope receiver, transponder VME receiver and a marker beacon receiver.

• Teleconquest Corp., Los Angeles, will produce four systems for Nike Hercules missile, under \$8.6 million contract awarded by Western Electric.

### Collins Radio Earns Profit for Fiscal 1959

Collins Radio Co. reported a net profit of \$5,718,817 in its fiscal year ended July 31, compared with a net loss of \$286,749 the year before. Sales rose from \$107,569,979 to \$117,564,139 and backlog from \$135 million to \$210 million, including \$30 million in contracts and foreign orders. The previous year's loss had resulted partly from sharp cost increases on contracts taken at the time of the Korean war. Better government scheduling, inventory adjustments in the result of contract completion and closer cost control produced the most favorable results for fiscal 1959.



### New styles for the man-about-space



Every time a space traveler leaves home (earth), he has to wrap himself in the complete environment necessary to his physiological and psychological well-being. Styling sealed space capsules to suit man's every requirement has been a major project at Douglas for more than ten years. Forty basic human factors areas were explored in those studies. Now Douglas engineers have evolved plans for practical space ships, space stations and moon stations in which men can live and work with security thousands of miles from their home planet. We are seeking qualified engineers and scientists who can aid us in furthering these and other out-of-this-world but very down-to-earth projects. Some of our immediate needs are listed on the facing page.


Dr. Eugene Konecni, Head, Life Sciences Section, reviews a new concept in space cabin design with Arthur E. Raymond, Senior Engineering Vice President of

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# AIR

for supersonic wind tunnel supplied by  
pressure tanks built of  "T-1" Steel



It takes vast quantities of high pressure air to create a supersonic wind. These 12 tanks supply air at 600 psi to a 20-inch supersonic flow down wind tunnel at NASA's Langley Aeronautical Laboratory, Langley Field, Virginia. They were designed and built of USS "T-1" Commercial Alloy Steel by Pittsburgh-Lima Moore Steel Co. Each tank is 63 feet high by 13 feet in diameter.

With total volume, pressure and available ground area specified, the problem in this design was to determine the most economical size and number of tanks to do the job. If made of standard boiler steel, the tank walls would have had to be nearly three times thicker than the 1½" made possible by USS "T-1" Steel. With this three-times-stronger alloy steel, the tank heads are only ½" thick, compared with a requirement of nearly 2" thick if made of lower-strength material.

These vessels are good examples of the savings possible with high yield strength USS "T-1" Steel. Much less steel was required; and they were easier to weld, fabricate and volume—and, very important because of space limitations, there was a huge reduction in ground area required. The vessels were designed to a working stress of 40,000 psi and 80% joint efficiency. The tensile strength of USS "T-1" Steel for pressure vessel applications is more than 110,000 psi.

Now USS "T-1" Steel saves. These vessels required much less steel than normally used—in them was a considerable reduction in freight costs. They required less material for foundations. Volume of weld metal was also drastically reduced. And they saved ground space in an area where available space was limited.

Why not find out what USS "T-1" Steel can do for you? Write United States Steel, 330 William Penn Place, Pittsburgh 30, Pa. (USS and "T-1" are registered trademarks).

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## Tunnel Diode

Tunnel diodes are now being offered as a sampling basis by various manufacturers in the RCA Semiconductor and Materials Division. Photo above shows one of the new diodes in its low inductance case.

## Stock Transactions

Transactions for the periods July 11, Aug. 10 and Aug. 11-Sept. 10 include:

**Bellman, Tuckwell Products**—Disposition of 1,000 common shares to Tuckwell D. Bellman Co. officers and directors resulting in a holding of 13,100.

**Kaiser Aluminum Ind. Acquisition**—Of 1,000 common shares through exercise of option by G. W. Kaiser, officer, resulting in a holding of 1,100.

**Standard & Western Airlines, Inc.**—Disposition of 1,000 common shares by J. H. S. Standard & Western, officer, resulting in a holding of 12,100.

**Sevenson-Schubert Ind. Acquisition**—Of 1,000 common shares by J. H. Sevenson-Schubert, officer, resulting in a holding of 13,100.

**Wagner Corp.**—Disposition of 1,000 common shares by W. F. Wagner, officer, resulting in a holding of 14,100.

**Wheeler Aircraft Corp.**—Disposition of 1,000 common shares by J. H. Wheeler, officer, resulting in a holding of 13,100.

**Yates Industries Corp.**—Disposition of 1,000 common shares by J. H. Yates, officer, resulting in a holding of 13,100.

**Zachary Industries Corp.**—Disposition of 1,000 common shares by J. H. Zachary, officer, resulting in a holding of 13,100.

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For more information on the new Klixon High Temperature Precision Switch, write for Design & Development Bulletin, DD-1015W-5.

Western Manufacturing — order inquiries directly to Minab & Controls' Southern California Office — 232 North Lake Avenue, Pasadena, California

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## Competition Rises in Ion, Plasma Fields

By Philip J. Klein

Washington—Growing activity and encouraging progress in the development of electric propulsion techniques to power rocket-launched, large-payload vehicles on interplanetary missions and/or to shift satellite orbit, were reported here during recent meeting of the American Rocket Society.

The meeting also revealed the sharp competition between ion and plasma propulsion techniques, measurement of the many between liquid and solid-propellant rocket engines. Most observers agree that it is too early to predict whether one technique will win out and many believe that both probably will find space propulsion roles.

## New Developments

Here are some of the recent electric propulsion developments cited by ARS speakers:

• **Cathodic electrode plasma accelerators**, developed by Lockheed's Menlo and Space Division, has demonstrated an

effective specific impulse of more than 2,000 sec, based on measured impulse and propellant mass. Lockheed has achieved maximum particle velocities of 80,000 meters per second and propellers of nearly 2,000 revolutions, according to S. W. Kauf and W. L. Starr of Lockheed's Ionics Physics Department. Efficiencies of more than 30% have been achieved under some conditions and a figure of 50% appears possible. Using plasma produced by electrode erosion, Lockheed's ownmost product that effective specific impulse of 5,000 sec should be realizable.

• **Cesium ion motor**, developed by North American's Rocketdyne Division, has achieved beam power level of 177 watts per square centimeter of ionization area, with thrust levels of  $1.6 \times 10^{-4}$  lb/sec. cm. Mass utilization studies indicate that 70% of the cesium reaches the cathode in the form of high energy ions and that over 50% was sputtered at the surface anode. To neutralize the ion beam, electrons were injected by a thermionic cathode near the motor's

exit aperture with the electrons being accelerated by the ion beam space charge, according to report presented by C. R. Dalgarno of Rocketdyne and R. C. Speiser and A. T. Fineman, now of Electro-Optical Systems, Inc., Pasadena.

• **Arc-jet engine** using hydrogen has achieved specific impulse of 1,500 sec in experiments at German Plasmatron Corp., according to a report by A. C. Dirsch and G. L. Cress. The Plasma Jet engine consists of a cathode with inductive and regenerative cooling, designed to enable electrodes and nozzle to operate at temperatures over 1,000°C are now being designed. Work is also underway that presents in the arc discharge should be one atmosphere or higher to achieve reasonable good efficiency in converting electrical energy into effective kinetic energy.

• **Experimental ion engine** now in operation at Electro-Optical Systems, Inc., which operates either with cesium or potassium as the propellant, has achieved beam currents of 12 ma and



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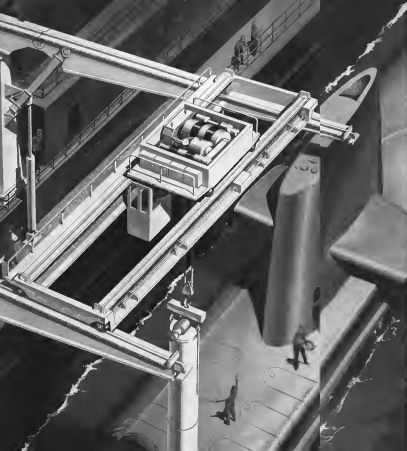


For information, call 212-693-0000 or 212-693-0001



## Mercury Tunnel Tests Under Way at AEDC

Multiple-exposure photograph of 10% scale Mercury capsule model test taken during wind tunnel tests at U. S. Air Force's Arnold Engineering Development Center's transonic test section. Data is gathered in transonic speed range from Mach 0.8 to 1.5. The model at right shows the capsule at a 50 deg angle to AEDC's Gas Dynamics facility. Run lasts for about 1/16 sec, smaller model at lower portion of the photo records measurements for purposes of comparison. Calibration probes are faintly visible.



## Threading the needle with a POLARIS missile using Westinghouse Load-O-Matic controls

Hoisting POLARIS missiles from a tender into the launching silo of an atomic submarine takes a hoisting system that combines ruggedness with extreme responsiveness and safe, sure, precision control—control so sensitive that the POLARIS seems to float in the air as it swings smoothly and gently into position at the submarine.

Westinghouse Load-O-Matic® crane control system was selected by Knight Steel and Iron Works® for this exacting and delicate handling operation because of its unerring sensitive precision performance. The combination of hoist, bridge and trolley controls operating with almost microscopic accuracy nullifies the pendulum-like swaying of the load. These positive, stepless speed controls provide movements at less than one foot per minute, yet will accelerate smoothly up to two feet per second.

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Donner's rugged new angular accelerometer weighs only 2 pounds.

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**RESOLUTION** 0.01% full scale or better  
**LINEARITY** 0.1% full scale  
**HYSTERESIS** Less than 0.01% full scale  
**DAMPING** 0.6  $\pm$  0.1 of critical  
**SIZE** 3 1/2" diameter  $\times$  3 1/2" high  
**WEIGHT** 2 pounds

The mechanically rugged and electronically rigid Model 4535 is one more basic technical contribution from an engineering team specializing in inertial systems interlocking time, acceleration, velocity, and other dynamic inputs.

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## Electric Propulsion for Space

Electric propulsion for space vehicles achieves a very high specific impulse by using a propellant of low mass which is accelerated electrically to extremely high velocities. Several basic types are under investigation, as reported at recent AASAC on Rocket Society Symposia, include:

- Ion propulsion employs propellant consisting of a stream of positively charged ions. These are shaped into a beam and accelerated by electrostatic fields using techniques similar to those employed in a cathode ray tube to focus and direct beams of electrons. To prevent blocking effect due to space charge, electrons must be injected into the beam as it leaves space vehicle to maintain its charge.
- Plasma propulsion uses a neutral (no charge) plasma of propellant which is accelerated and directed by means of external magnetic fields which react with field produced by current flowing through the plasma. Technique involves some of the same principles under investigation for controlled fusion power.
- Arcjet propulsion uses an electric arc discharge to produce ionized heating of propellant gas which expands in a suitably shaped nozzle to form a high velocity jet. This type of engine does not use external magnetic fields to augment propellant velocity.
- Heated gas propulsion employs a gas, such as hydrogen, whose energy level is raised by passing it through an electrically heated tungsten heat exchanger.

a thrust of 65 dynes, which operated with potassium, General Northrup reported. Company has developed new techniques for controlling and measuring vacuum at ultra-high rates fed to the ion chamber in which the vapor is electrically heated through a membrane.

Both ion and plasma engine techniques are under investigation by the National Aeronautics and Space Administration's Lewis Research Laboratory in Cleveland. Primary emphasis is on the ion engine, because its operation is better understood and performance is more readily predicted, according to NASA scientist W. E. Meedel and W. D. Ryde. However, there is strong interest in plasma arc engines.

### Propulsion Principles

Although proponents of ion and plasma engines disagree on many points, there is general agreement that at the present time the principles of ion propulsion are better understood than those for plasma propulsion. Design of an ion engine can draw on existing know-how developed for the design of electron and microwave tubes. The design of a plasma engine is much more dependent upon extensive laboratory experimentation because of the present inability to predict the complex interaction between magnetic-electric fields and the plasma.

It also is generally considered that an ion engine can produce a higher specific impulse than a plasma engine, because it can accelerate particles to higher velocities. (Specific impulse is a measure of the thrust achieved per pound of propellant per second.)

However, Lockheed's Kutz and Stein, both proponents of plasma engines, point out that there is another impor-

tant factor to consider—the total thrust developed per unit area, referred to as "specific thrust." A low specific thrust involves a weight penalty because of the additional structural supports, propellant feed lines and insulating surface required.

The Lockheed scientists point out that a plasma engine has a specific thrust that is at least 100 times greater

than that of an ion engine because of inherent limitations imposed by voltage breakdown considerations in an engine that uses electrostatic fields for particle acceleration.

However, a report by David B. Langman of Thompson Ramo Wooldridge and Bernard R. Cooper of the University of California at Berkeley suggested that the specific thrust of an ion engine can be increased through the use of a series of accelerating electrodes, each of which contributes to the total thrust. They conclude that there are many "formidable practical difficulties associated with (these) concepts," but they believe the potential gain may justify further investigation. Added advantage of the technique is the ability to achieve much thrust levels with a low specific thrust, as ratio of beam diameter to acceleration distance required.

### Unit Weight

The weight of an ion or plasma propulsion unit will be small compared with the weight of the nuclear power plant needed to supply it with the required electrical power. For example, the SNAP-8 nuclear turbo-electric power generation system now under development will weigh about 2,500 lb. in the 30 kw. version, around 3,000 lb. in the 60 kw. version.

Thus the efficiency with which the



Gravity Locator Used in ICBM Tests

instrument to measure the mass and center of gravity as these vary in the Air Force Titan and Minuteman intercontinental ballistic missile series have been developed by Dyna Systems Corp., Irvington, Mass. Device provides indirect air weight and CG along roll, pitch and yaw axes during re-entry and is used principally in pre-flight tests in wind tunnels. Company says the device has an overall accuracy of 0.005 in. over an operating range of 1,000-4,500 lb. Unit is air transportable for field testing.



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### Space Oxygen Unit

Closed circuit oxygen system carried on its astronaut's back to provide breathable air has been designed by All-American Manufacturing Division of the Giant Corp. Unit weighs 16 lb., stores 6 hr. oxygen supply.

precision and controls electrical energy into thrust will be an important consideration. Generally, the ion engine is given at least a slight edge over the plasma engine in efficiency, although Lockheed's Kistler and Star believe there is no reason to believe that the two won't be comparable in this respect.

The ion engine requires several voltage supplies whereas the plasma engine requires only a single high voltage supply. However, some plasma engines in space a sizable number of capacitors to store up the high energy required for normal discharge through the plasma.

### Thrust Control

The ion engine normally is controlled by a continuous regulator device in which thrust level is controlled by the amount and rate at which vapor is fed to the reactor. Some plasma engines use ionization controllers, and others use pulse type propellant units in which applied thrust is controlled by varying the firing rate.

Ability to operate reliably over extended periods of time measured in months or even years will be an important criteria for selecting an application electrical propulsion system. At the present stage of development it appears probable to predict whether an ion or plasma engine will have a decided reliability advantage over the other.

Here are some of the electric propulsion investigations under way at Lewis Research Center as reported by NASA's Marshall and Berlin.

• **Electro-thermal propellers:** NASA has launched a small-scale research project to investigate possibilities of elec-

## Forging Eliminates PROFILE Machining



18 inch aluminum impeller



This big 18" aluminum\* impeller was originally machined from a rough forging... requiring many costly man-hours. Then Arcturus, utilizing techniques they have pioneered, developed a method for forging the vanes to the finished state shown above... saving considerably on material, eliminating all profile machining and reducing the cost of the finished part substantially. Clean flow follows the contour of the part, providing greatest possible strength.

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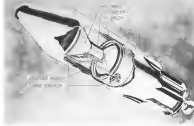
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## SNAP II Nuclear Reactor Flight Concept

Flight configuration of SNAP II small nuclear power system experimental reactor (AW Nov. 30, p. 17) is shown in this concept by Atomic International Division of North American Aviation, Inc. Reactor produces 90,000 watts of heat and weighs 218 lb.

forming efficient, long-duration electric jet at the propellers and power both suitable for space propulsion. Agencies also is investigating use of radio frequency fields for heating propellant gas. Likewise, used as the working fluid, is introduced into a tube which is heated by an RF coil that is fed by a 10 mc, 1 kw. power supply. Tests to date indicate that the RF reactor does produce efficient heating but NASA has not yet obtained quantitative data on the efficiency of energy transfer to the gas.

• **Threading-wire acceleration.** Acceleration of plasma along a tube by means of a series of coils spaced along the tube which are excited by polyphase RF energy so as to produce a magnetic field or magnetic inner which appears to accelerate down the tube. Also is under investigation. Using a 1 kw. single-phase power supply for coils, tests, NASA found that velocities of 10,000 meters/sec could be achieved. Furthermore, tests, using a three-phase 40 kw. power supply, are aimed at determining jet character, mass thrust and efficiency as well as nature of reaction forces. Propellant materials to be used in experiments include lithium and nitrogen.

• **Crossed field acceleration.** One of several possible systems for obtaining plasma acceleration through the use of crossed electric and magnetic fields which NASA is investigating employs the plasma as a conductor carrying a current across a magnetic field with a resultant force being exerted on the plasma. Tests to date on a jet type accelerator indicate that velocities of about 10,000 meters/sec are obtainable.

• **Pulsed plasma acceleration.** Another possible plasma acceleration mechanism employs the expansion of a current loop due to self-induced magnetic field which results in driving the conductor outward.

The Lewis Research Center is investigating three types of pulsed discharges:

• **Expanding a wire across a pair of multi-type electrodes** gives an axially down plasma. Tests show that about 10% of the wire mass is ejected at velocities of about 5,000 meters/sec.

• **Surface discharge between two closely spaced electrodes** embedded in a block of insulating material is being used to investigate current loop expansion technique. Such an air tube exposed into a circular or toroidal configuration, discharging from the electrodes a mass of plasma with circulating electrical currents and corresponding magnetic fields.

• **Use of a backstop near the jet** discharge enhances the strength of the magnetic field with propellant supplied as a molecular beam which condenses on the surface of the insulator bridging the gap between the two electrodes. Conductivity discharge across the gas propellant and across magnetic field forces the plasma out at right angles to the gap. More preliminary experiments indicate velocities of 20,000 to 40,000 meters/sec.

NASA scientists point out that for the surface discharge and backstop techniques, the acceleration force decreases rapidly as the plasma moves away from its initial position. This requires that system have a low time constant so that maximum possible im-

pulse stored in capacitors be available for speedy discharge.

Lockheed's plasma propulsion experiments were aimed at using a pair of cylindrical electrodes connected to a low inductance, high energy capacitor to supply discharge energy. Leads between the capacitor were arranged to maintain low inductance and to maintain direction of discharge forces.

With the capacitor charged to a high voltage and the region around the electrodes evacuated, discharge is initiated by introduction of plasma between electrodes. In one set of experiments, plasma was produced by exploding a few wires mounted between the electrodes at right angles to the plane of the discharge current. In a second set of experiments, a discharge was produced by introducing a rare amount of argon gas between electrodes with subsequent electrode erosion under discharge conditions producing the major portion of the plasma.

Magnetic fields produced by the large current in the discharge and the active circuit elements accelerate the plasma. The magnetic field of the opposing current in the lead postulating the discharge provides the direction and propulsive force for accelerating the plasma.

Using exploding wire to produce the plasma, Lockheed obtained maximum plasma velocities of about 70,000 meters/sec, as measured by an electric probe. Movement measured as pulse of 1.5-20 microseconds, equivalent to specific impulse of 2,230, was obtained with a 1 and tungsten wire. Using electrode erosion in the plasma source, Lockheed obtained measured impulses of 600 microseconds with as little as 6 micrograms of argon gas to initiate discharge and with a specific impulse of 10,000.

Nearly applied technique for controlling and measuring movement of alkali vapor introduced into expansion chamber will make it possible to measure quantitatively the ionization efficiencies of a variety of inner surfaces and ion configurations, Samuel Nauchik, Electrical Systems, Inc., told the ASEE.

The new vacuum and reducing technique makes use of the fact that glass can transport alkali ions under the influence of an electric field. If a molten salt or molten film is placed on one side of a glass and an electric field is applied the alkali ions migrate through the glass to the opposite side where they are neutralized to form an alkali metal.

A preliminary analysis of the possible use of charge-exchange interaction between fast charged ions and neutrals shows it is not a good way to cut the ion speed to neutralize ion engine exhaust, indicates that this approach is not feasible, Nauchik reported.



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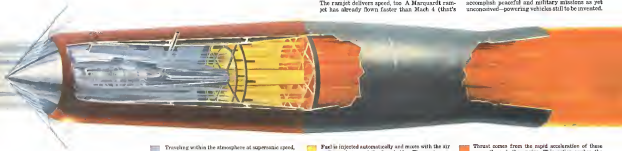
The ramjet family of engines for aircraft, space and space vehicles is unique because of its simplicity of operation. Without moving parts in the basic engine system, the ramjet develops compression ratios of more than 100 to 1 at 3500 miles an hour—yet can use kerosene as fuel. By comparison, your piston-engined car needs "super-premium" gasoline for compression ratios of only 10 to 1.

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## HOW THE RAMJET WORKS:

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For a reprint of this advertisement you are invited to write: Roy R. Marquardt, President, The Marquardt Corporation, Corporate Office: Van Nuys, California.





## AIRDROP TO THE "LOST BATTALION"

Banking gently, the big biplane slipped down out of the low clouds, leaving a sudden burst of enemy gunfire, and robed over the hills, heavily wooded terrain. Glancing back at his observer, the pilot nodded to the ground. The observer began dropping supplies over the side. Somewhere below, hidden by the dense foliage and undergrowth of the Argentine Forest, sat unperceived on all sides by Germans, lay the injured and dying men of America's "Lost Battalion."

It was October 6, 1918, the date of the first aerial supply drop in combat history.

With its prize completed, the two-seater DH-4 bended back for its takeoff. Lower down of the A.E.I. 50th Aero Squadron. At the

controls was Lt. Harold E. Gantler, a flight commander from Chicago. His observer was Lt. Edwin B. Blockley of Wichita. Later in the day Gantler and Blockley took off on their second mission. They never saw back. Ground fire sent them crashing to their deaths near Hinnville, France.

The story of the "Lost Battalion" is today more legend than fact. Actually, the men were never lost. A battalion of the 77th "Strike of Liberty" Division and parts of a machine gun battalion were cut off after a rapid advance beyond the front lines during the Meuse-Argonne offensive.

By dawnbreak on October 3, the men were encircled by Germans and exposed to heavy shelling and machine gun fire. For the next

four days they were ravaged by hunger, thirst and death and subjected to continuous enemy attack. Including a barrage from their own artillery.

On October 6, the 50th Aero Squadron, which had flown its first mission only five weeks before, was called in to air-drop supplies. The squadron flew 15 missions the first day. One of these was out from the "Lost Battalion" by carrier pigeons, giving the Battalion's location, proved in slight but serious error and the trapped men received only a fraction of the supplies. Finally, however, an airdrop team spotted the correct position and the remaining men were rescued on October 7.

The planes used in history's first recorded airdrop were DH-4's designed by Geoffrey de Havilland, the famous British designer. In the first year of the war, 4,700 of the big British ships were built under license in the United States. Stopped, fast and reliable, the DH-4 was at some point in its career qualified for every conceivable type of duty. In its original production form the DH-4 was powered by a 240-hp. R.E.B. engine to a top speed of 120 mph. The somewhat heavier American version, powered by a 400-hp. Liberty engine, had a top speed of 123 mph.

Because its main fuel tank was located between the pilot and the observer—directly in the line of enemy fire—the DH-4 was labeled the "Flying Coffin," but it was no more vulnerable in this fashion than other aircraft. Its armament consisted of two synchronized forward firing Vickers machine guns and two aerial mounted Lewis machine guns. The DH-4 was still in service in 1952 when Harold Gantler and Edwin Blockley were posthumously awarded Congressional Medals of Honor. DH-4's similar to the ship they flew in immediately continued in U.S. military and government service for almost another decade.

### HERITAGE OF THE AIR

One of the most inspiring chapters in the history of technical evolution is the story of the men and flying machines of World War I. It is the highly personalized story of brave men—and the wood, wire, brass, and rudimentary technologies that conceived man's power to airplanes. Today, Leach Corporation celebrates its 40th year in electronics with the presentation of this Heritage of the Air series.

Leach thanks Col. D. F. Wynn, Jr., Commanding Officer of the 50th Aero Squadron during the above action, for his help in preparing this tribute.

Technical Director for Donations of the Air is Major Randolph S. Brown, USAF.

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This year Leach Corporation celebrates its 40th anniversary in electronics with a reaffirmation of Val Leach's time honored principles: Solving problems is the core of the Leach philosophy of doing business. Leach will continue to base its success on anticipating customer needs and meeting them with advancements related to specific requirements.



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## Pyrographite May Cut Nose Cone Heat

Waltham, Mass.—New forms of graphite, with controlled crystal orientation that gives it novel thermal, electrical and other properties, may enable helicopter nose cone noses to resist erosion to operate at higher temperatures (AVN Nov. 16, p. 10).

Oxetized graphite has been produced in small quantities in research laboratories for more than 50 years, but can be produced in commercial quantities by a new process developed by Raytheon Co. with the partial sponsorship of the Navy's Special Projects Office.

A pilot production facility has been constructed by Raytheon in Lawrence, Mass., which will be capable of accepting forms or molds in shapes sizes ranging up to 12 in. and in planning the establishment of a full scale facility capable of handling larger shapes and producing greater quantities of the material.

Problems still remain in adapting the process to still large scale production, but there are under active investigation in the company. Called "Pyrographite," by Raytheon, the material operates at the same temperature as ordinary graphite (upped merely 6,500°F), which has the highest temperature limit of any elemental material. Thermal and electrical conductivity of Pyrographite, moreover, in straight anisotropy—that is, it is higher by several orders of magnitude in a plane parallel to the surface than at right angles to it. Raytheon claims, also, that the material has the properties of high density and impermeability to gases.

In the new process, rankles of carbon or graphite are obtained from a carbide-iron gas and deposited on a substrate (steel), with controlled crystal orientation. Pieces formed entirely of Pyrographite can be produced by deposition on the base surface of a graphite anvil, which is then etched away from the workpiece.

In the plane parallel to its surface, Pyrographite has a higher heat conductivity than copper, while at right angles its conductivity is lower than normal graphite and, also, lower than in some low-conductivity ceramics. Ceramic materials commonly increase in thermal conductivity above some characteristic temperature because of the contribution of radiation to thermal conductivity. Raytheon says that no such contribution has been shown to date for graphite or Pyrographite, which makes the thermal resulting properties of Pyrographite emergent even more favorable with those of conventional metal thermal insulators. This contention, the company says, has been verified by very high

temperature arc plasma and rocket engine tests.

Other properties are:

- **Electrical.** Results of initial tests on sheet electrical conductivity parallel to the new material are similar to its thermal characteristics. Resistivity at right angles to the surface increases with higher temperatures, whereas it decreases in the direction parallel to the surface. The degree of anisotropy is of the order of 1,000 to 1 for material prepared at 2,000°C. Results along the lower planes is considerably less than for normal graphite, which is considered a good conductor, whereas the lower is a far greater than for graphite.

- **Density.** A significant property of the material is compared with normal graphite is its high density. The theoretical density of normal graphite is 2.25 grams per cubic centimeter; ordinary graphite ranges from 1.6 to 1.7, while oxidized graphite runs from 1.7 to 2.4. Pyrographite has been prepared with densities as high as 2.25. Density increases with the temperature of preparation because of a higher degree of crystalline orientation at higher temperatures.

- **Mechanical properties.** Strength-to-weight ratio of the material is higher

than for Series 110 stainless steel at low temperatures, while above 2,000°C which normal graphite has one of the highest strength-to-weight ratios known, is less than five times in great tests conducted with Pyrographite and normal graphite in high compression stress planes such as those produced by a high velocity, high temperature, rotating stream of solids and gases resolved in slight corners of the oxidized graphite, compared with almost complete breakdown of the normal graphite. This property is attributed to the oriented crystal lattice which presents incompressible basal planes in the gas stream.

- **Impermeability.** A characteristic of interest for applications to nuclear reactors is the material's impermeability to gases. Using a standard mass spectrometry leak detector, no permeation by helium has been detected, even after flowing at 2,500°C and in cooling or flow as thin as one or two mils. Graphite, due to its high density and low atomic number, is frequently used as a moderator in nuclear reactors. Oxidized graphite is denser than normal graphite, so it possesses the advantage of providing more atoms per unit volume for moderating neutrons. Because the material is extremely pure or prepared, Raytheon says, it requires



PYROGRAPHITE, an elemental material consisting of a graphite crystallite deposited in a highly oriented manner, with thermal shock from heat. The area that at right hand is a hole through a sheet of substrate. The material can be deposited on a substrate (steel) or in a honeycomb graphite matrix.

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no further perfection for reactor purposes and eliminates the problem of potential poisoning from impurities found in ordinary graphite.

Because it is impossible to press, the company points out, it can be used as a coating for hot elements to keep gaseous fission products out of the coolant system, while its strength at high temperatures will enable it to contain appreciable pressures of fission products.

## Production Process

The process of producing Pyrographite as a commercial grade that Rockwell is developing has reached the point where it is now possible to reproduce shapes of various diameters with wall thicknesses up to one-half inch. This can be on a substrate or a commercial graphite form. The process is based on high temperature pyrolysis of carbon containing vapors.

The development and pilot production work to date has been with resistance or radiation-heated forms, capable only of preparing samples for property measurement and small commercial pieces. Because the degree of oxidation of the material is highly dependent on the temperature during deposition—each a temperature range extending above 2,000°C—process control problems increase rapidly with increasing size of production pieces.

The most obvious structural difference between Pyrographite and normal graphite, the degree of orientation of the graphite crystallites, lies in the stacking of the basal planes.

In the crystallite of normal graphite, each layer has a well-defined position relative to the neighboring layer, whereas in Pyrographite the stacking of the layers occurs in a random fashion. The randomness in layer stacking detracts the periodic repetition of atoms present at right angles to the basal plane so that the structure can no longer be described as a repetition of unit cells. It is this difference in structure that gives Pyrographite its difference in mechanical, thermal and electrical properties.

## Rocketdyne Develops Portable Solid Plant

McGregor, Tex.—Coyne's process pilot plant for casting solid propellant is going into operation here at the solid rocket plant of Rocketdyne Division of North American Aviation, Inc.

Quickcast pilot plant was trucked here from California on a 30 ft trailer, and this mobility demonstrates the potential field loading capability of the system. Plant has a maximum casting capacity of 500 lb. per hour, and a maximum of 5,000 lb.

Safety stems basically from the fact that only a small amount of the propellant material is in the range of curves, while the general batch-casting methods require relatively large amounts of propellant materials to be combined in a single batch. Low cost and versatility are also cited as advantages for the new process.

Rocketdyne has used its own Conquest system with several solid propellant combinations and is continuing to apply the process to a variety of propellant combinations under contract to the Manufacturing Methods Division, Aeronautical Systems Center of Air Materiel Command.

## Scientists to Discuss Space Trajectories

First symposium on space trajectory determination, covering fundamental retrograde concepts and units, rudimentary space, astromechanics, trajectory computation and optimization, space mission and energy and many, will be held Dec. 14-15 at the Langford Hotel, Orlando, Fla. Registration, \$10, is included.

Symposium includes Kerol A. Elrod of Convair Division of General Dynamics Corp., and Dr. C. A. Whitney, Smithsonian Astrophysical Observatory.



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# Paint Gives Missiles Thermal Protection

By Michael Yaffee

St. Louis, Mo.—Thermal protection that can be painted on missiles to the exact temperatures required is now being offered to engineers by Emerson Electric Manufacturing Co.

The protection, which comes in the form of a family of tailor-made sublimating paints, is offered as a low-cost, lightweight means of controlling the high temperatures induced in missiles and space vehicles by aerodynamic friction, solid heating and rocket exhaust gases.

To date the material has been used on the nozzle of the Honest John rocket and is under evaluation as a coating for the rocket's supersonic air in advanced versions of this rocket now under development. The material is also being evaluated for the Little Joe capsule, the Project Mercury capsule and, reportedly, for all three stages of the Minuteman missile.

Without Aeronautics Research Division of National Aeronautics and Space Administration has run a series of tests, including heating and erosion, on small coated samples and reports that the results are sufficiently encouraging to merit further evaluation of the material for possible use on the glass fiber polycarbonate laminate body of its Little Joe capsule. That coated Little Joe capsule is scheduled for a flight test the first week in December. PARC has also coated line solid propellant rocket engines with the material and considers the coating definitely worthy of consideration for advanced structures such as Dyna-Soar.

The sublimating paints, developed by Emerson's Robert Feldman, are called Thermo-Lag. At present, there are four formulations available which sublimates at 230F, 498F and 800F. Under development are three other Thermo-Lag formulations which will sublimates at 850F, 3,100F and 1,450F. Thermo-

ally, says Feldman, there is no limit to the sublimation temperatures that can be built into the basic Thermo-Lag formulation through the use of temperature elevating or degrading agents.

## Material's Composition

Essentially, Thermo-Lag consists of inorganic salts in organic and inorganic binders. It is mixed and applied like a paint by either brushing, spraying or dipping. Emerson is currently working on a Thermo-Lag formulation that will have structural strength as well (by using it as a filler in porous materials) but this is in a very early stage of development. One of the principal attractions of the Thermo-Lag formulation is that the material can be used at approximately room temperature, around 80F. This means that it can be used to coat live solid propellant rocket engines.

The fact that the material can be applied like a paint is also important. It means the material can be used on odd-shaped and otherwise difficult-to-cut structures. It was one of the main considerations in NASA's interest in the material for the Little Joe capsule.

## How It Works

In a somewhat simplified manner, this is how the 230F Thermo-Lag formulation works. As heat is generated, it is absorbed by the Thermo-Lag coating until the coating reaches its sublimation temperature, in this case, 230F. The amount of heat absorbed will depend, of course, upon the amount of coating. Roughly, it will take 47 lbs. to save the temperature of one pound of 230F Thermo-Lag 1F.

When the temperature reaches 230F, the Thermo-Lag sublimates. In going from a solid to a vapor state, each pound of the coating absorbs another 700-800 Btu. Then the exposed coating has to work its way through the interface to the boundary layer and then takes up more Btu. The repeated coating thickness the boundary layer, saving as a gas shield to further protect the underlying structure from heat. At extremely high temperatures, the gaseous Thermo-Lag will combine in the compound and then break down into heat.

Overall, one pound of Thermo-Lag will absorb about 5,000 Btu from the first heat input to final decomposition. But this figure, says Feldman, will increase with the rate of heat input. The more heat that is applied, the greater

the amount of gas that will form (Rate of heat transfer to the material and the thermal conductivity of the material will determine the thickness of the coating that will sublimates.) The greater the amount of gas formed the greater the energy required for them to diffuse into the boundary layer and the thicker the boundary layer becomes. Consequently, says Feldman, the seven 48-in. diam. could become 15,000-20,000 lbs. absorbed per pound of Thermo-Lag at a heat input or ablation rate of 5,000-7,500 Btu/ft<sup>2</sup>/sec. Start all the Thermo-Lag coating is gone, the underlying structure remains or is close to the sublimation temperature of the specific formulation chosen. For the Little Joe capsule, PARC is using their 230F version to protect the plastic body could take, those the 230F Thermo-Lag formulation for this project.

For the Dyna-Soar, it is expected that NASA will need a material that will sublimates at 1,700F, and Emerson is ready to start work on a Thermo-Lag formulation to meet that high temperature requirement.

## Determining Thickness

Once the top permissible temperature for the structure is determined and the right Thermo-Lag formulation is selected, the next step is to determine the thickness of the coating required. From the trajectory profile of the mission the vehicle will have to perform, heat input rates can be determined for each interval of the flight. In our first-second segment of the trajectory, for example, heat input to the vehicle may be 100 Btu/ft<sup>2</sup> or a total of 500 Btu/ft<sup>2</sup>.

From the chart of the selected Thermo-Lag formulation, on the 230F coating it is learned that the material can absorb 7,000 Btu/ft<sup>2</sup> at the rate of 100 Btu/ft<sup>2</sup> sec. Dividing 500 Btu/ft<sup>2</sup> by 7,000 Btu/ft<sup>2</sup> gives .07 lb./ft<sup>2</sup> for this segment of the trajectory. Then, dividing .07 lb./ft<sup>2</sup> by 76 lb./ft<sup>2</sup>, the density of the Thermo-Lag formulation, gives the required thickness of .002 in. or .012 in. Adding the results from each segment of the trajectory will then provide the total thickness of the specific Thermo-Lag formulation required.

## Weight Savings

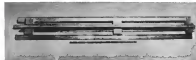
By then taking a protective coating to a specific application, says Feldman, it is possible to reduce important weight savings. In addition, the material has high thermal shock resistance, as one demonstration, it went from ambient temperature to 4,500F in 15 milliseconds successfully. In the case of the Honest John rocket, says Feldman, which its avoids the solid propellant grain and is essentially a coated shell structure, says Feldman, Thermo-Lag makes possible the substitution of



WORKER SPRAYS outside area of Honest John rocket nozzle with Thermo-Lag (above). Coating is sprayed and cured (below) with relatively simple setup of ITS and infrared lamps arranged in ring around throat section.



THERMO-LAG jacket on Honest John nozzle remains intact after impact of the rocket. Jacket is scored to provide greater surface area.



RESONANCE SUPPRESSOR BEFORE FIRING  
MATERIAL: ALUMINUM  
THERMAL PROTECTION "THERMO-LAG" - .015"



RESONANCE SUPPRESSOR AFTER FIRING  
MATERIAL: ALUMINUM  
THERMAL PROTECTION "THERMO-LAG"

SOLID PROPELLANT rocket resonance suppressor, made of aluminum and coated with Thermo-Lag, is shown here before and after 1.6-sec exposure to 4,500F at 1,000 psi.



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### Redstone's Mercury Role

Washington—Tentative schedule for use of the Redstone satellite in National Aeronautics and Space Administration's manned capsule program now calls for six shots without survival life, not carrying a chimpanzee in the capsule, and the eighth and last manned use of the seven Mercury space pilots. Plans probably will not begin before early spring. A second plan being discussed is to test three capsules, except except for suborbital tests, plus a chimpanzee in the fourth, and test space pilots in the last two capsule shots if earlier launches are sufficiently satisfactory.

an aluminum structure, with a resultant weight reduction of 50-75%.

Used on the outside of the Honest John missile, Thermo-Lag serves the same function as a water jacket (only it is an ablative coating) without the weight or complexity, by reducing the missile's metal temperature. In this application, the Thermo-Lag jacket is scored to provide additional surface area and passages for the cooling gases and to better enable the jacket to expand with the metal.

### Radiant Emission

In applications where radiant emission becomes a significant factor, it is also possible to vary the surface thermal emissivity of the Thermo-Lag coating by the proper choice of formulation without basically changing size of the other physical or thermodynamic properties of the material.

But one of the most important attractions of Thermo-Lag, says Feldman, is the fact that sublimation transparent is not a function of the rate of heat input.

This characteristic, he believes, makes Thermo-Lag superior to ablative systems (based on materials like Teflon and silicon), currently being used on some missile nose cones.

### Not All Enthusiastic

Many potential users of Thermo-Lag, however, are not quite so enthusiastic as Feldman. The material is still a comparatively new development and as such, admittedly, has not yet reached its full potential nor involved all its drawbacks. For one thing, Thermo-Lag is hygroscopic and, in the event of a rain just before launching, could pick up enough moisture to interfere with the flight of a white oak as the Little Joe and the functioning of its electronic equipment. NASA has made some effort to develop a vinyl or polyurethane gas-tight coating that could be used very at launch and leave the Thermo-Lag clean and dry.

But even without such a coating, NASA's PARC group doesn't consider this drawback serious enough to prevent the use of Thermo-Lag.

McDonnell Aircraft engineers, who are evaluating Thermo-Lag for the Project Mercury capsule, feel that while everything Emerson says about the material may be true, the big question that still has to be answered is whether it will do the specific job required on the Mercury capsule.

At this point, Thermo-Lag is simple one of some heat protection systems. McDonnell is currently investigating for the Mercury project, says one engineer, not the answer to a standard-size space rocket's project.

### Hawker-Siddeley, Nord Enter Into Missile Pact

Fair-Port Aeronaut and the Hawker-Siddeley Group entered in a reprint jointly the Mach 2 target missile, the CT-41, recently developed by the French manufacturer. The CT-41 is powered by two jets mounted on the wings of the target missile.

Under the Franco-British agreement, Hawker will manufacture to build and maintain the missile and personnel will handle all efforts throughout the British Commonwealth. Nord's earlier target missile, the CT-38, achieved some considerable success with NATO.

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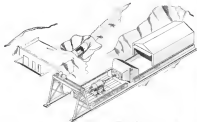


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POLARIS test stand at Naval Ordnance Test Station, China Lake, Calif., has metal housing (right) which rolls back over rocket and ammunition. Instrumentation cabin fixed into building at left, through tunnel up hill to data reduction and control center.

## Facility Tests Solid Propellants

China Lake, Calif.—New solid rocket static test complex capable of two drag capsules at up to 3-million-lb thrust has been completed at Naval Ordnance Test Station here.

Announced recently at solid propellant capsules, the facility adds to advance test accuracy which is 400% higher than previous standards. Installation cost \$675,000 and is made the largest now and will start a full scale Polaris fuel ballistic missile capsule test program late this year.

Data acquisition, recording and associated equipment is such that the capsule will be able to analyze propellant characteristics to within 0.25% error, as compared with the previous standard of 1%.

Designed so such that the stand will accommodate normal burning thrusts of 1 million lb., while peak thrust of up to 10 million lb. will be handled. Facility was built for Special Projects Office of Naval Bureau of Ordnance.

Test bay is 35 ft. long, 50 ft. wide and can accommodate capsules larger than 6 ft. in diameter, 90 ft. long and weighing up to 100,000 lb. Drag test and instrumentation blockhouse is located a quarter mile away, buried in a hillside, 37 ft. higher than the test stand.

Engineers are first to be brought to a conditioning building where atmospheric conditions of temperature, pressure, humidity are made to order to match the expected environment of Polaris.

Structure also serves as a storage magazine and can maintain constant temperature within plus or minus 3° in the storage from 70° to 110° at all year. Engines are pushed up against

instrumentation which is backed by 12 in. of steel armor plate mounted on a concrete block 13 ft. thick and 15 ft. high.

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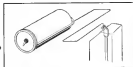
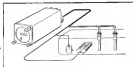


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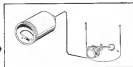
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## MANAGEMENT

### Data Systems May Supplement Weapons

By William H. Gregory

**Boston**—Some companies are beginning to erect datacenters toward defense business in the 1950s on the premise that a new kind of system built around the gathering and processing of intelligence will be a major factor in maintaining national security.

This Gage is one. Another is Thompson Ramo Wooldridge, which has just opened an Information Laboratory specializing in this and allied fields. Companies which already are heavily in personnel involved in the data processing field—IBM, General Electric and others—could also be expected to play major roles if such a trend develops.

General Electric Co. has most recently established an Information Systems Division within its Defense Systems Department to design and develop complex man-machine systems involving computer, display and data storage and retrieval equipment as well as related nonhardware techniques. Dr. Leodon E. Salas of General Electric's Computer Department was named manager.

Creation of the L-series communication system which USAF is developing may be initial efforts in this area. The 462L weather system with Boeing Aviation Corp. as prime contractor, for example, offers an indication of how such a system would be constructed (AW Oct. 6, 1958, p. 80).

#### Disarmament Factor

Disarmament may be a key factor in such a prospect. Rep. President Richard S. Lapham, who has just been named deputy for technical affairs on the President's Joint Committee for Disarmament Study headed by Charles A. Goodrich, feels his committee will be on the right side of the crisis if disarmament does come. The committee's report is due by year end.

If disarmament does come, Lapham

feels, it will not mean the end of defense systems but rather the transition to a new kind of system. The transition will be a long slow one, he believes, and in the beginning would be more costly than current weapon systems. A system such as Lapham has in mind might comprise these elements:

- Space systems on the order of the Soviet satellite reconnaissance system now under development
- Aerial inspection, how much depending on the degree of U. S.-Soviet agreement
- Ground control inspection parties at air fields, transportation centers, etc.
- Peripheral inspection through use of long-range radar as in the EMEWS system, air sampling and possibly other types. The EP-17 radar in Turkey and the Abnott is another example of current types in use.
- Data processing systems not only to handle information from the previous sources but also to search open techni-



**Sikorsky S-60 Crane Airlifts S-58**

One of 46 Sikorsky S-58 Army helicopters is shown being airlifted by Sikorsky's S-60 crane crane during a shift of on-board and repair facilities. The S-58, which weighs down from each, were carried 60 miles from the Sausalito, Calif., Naval Air Station to Sikorsky's plant in Bridgeport. Job was completed in several flying hours. City of Bridgeport is in background.



Maxim JEM-8 Silencer on run-up duty on F4U.

## MAXIM CUTS NAVY JET NOISE 25-30 DB

Thoroughly field tested by an independent acoustic engineering firm . . . requiring no water area when afterburners are used . . . the Maxim JEM-8 Mobile Exhaust Sound Suppressor reduces jet exhaust noise by 25 to 30 db.

Built for high temperatures, the JEM-8 is a portable, all-metal spider type unit with a maximum weight of 10,000 lbs including undercarriage. Engineered for all present types of jet aircraft, it is available with adapters for various airplane configurations.

Shown here in use at a naval air station, the JEM-8 will shortly be on duty at many other Naval and Marine Corps air stations. A commercial jet version, the JEC-8, is available for post-burn engines.

For noise suppression, consult Maxim — for it is here that Silence Is A Science.

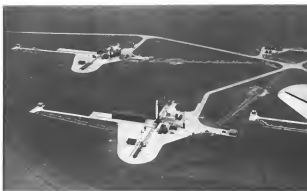


JEM-8 with undercarriage raised for test stand.

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## British Thor IRBM Site at Feltwell

One of two Thor intermediate range ballistic missile sites now operational in the British Isles (AW July 13, p. 20) is shown in the Feltwell complex. Nations eventually will have 20 sites. Each of the operational units has three missiles and three pads.

of literature for technical intelligence.

Peace is not a vacuum. Leghorns believe, and this view takes a more sophisticated approach to disarmament than the beat-the-grass-into-plush strategy of the 1920s and 1930s.

Thus defense systems would be designed to introduce areas of stability, not eliminate them. The highly complex intelligence systems would have three broad tasks.

- Warning of operational systems, that is, to provide exact data on what types of weapon systems are in being in other nations. This would include an outline of such things as missile launch sites and aircraft movements to give warning of intentions.
- Providing data on numbers ranging from force levels to production levels.
- Providing technological development information.

### Balance of Power

With reliable data from all three levels—which implies the agreement of all parties either to allow it to be obtained freely or to deduce it—then becomes theoretically possible to match one's own forces precisely to the enemy's capabilities and gain a zero-profit balance of power.

A certain amount of good faith among the parties seems necessary, though

having the system on a highly sophisticated intelligence net does little to increase human fallibility or duplicity.

Should such a system be successfully introduced, the initial cost for the necessary expensive components could be high, at least initially. But as there it would also become possible to reduce security costs as the intelligence system became more efficient, more delicate spending would thus be required only to meet previously known threats and not an unknown number of capabilities of which only a few might actually be intended for use.

The Thompson-Rama Woolbridge view was voiced by Dr. Steven Ramo, executive vice president, at the dedication of the Intelligence Laboratories, which are headed by Dr. John M. Silber.

"In the 1960s," he said, "the major military project will be in the intelligence field. Just as greater bombs have given rise to means for defense and our concern with II-hands has changed to a concern about intercontinental ballistic missiles, so the future will make a change and a battle for supremacy in intelligence."

We have already seen the commitment by the hostile camps of an adequate amount of force to make possible total destruction of the other and will soon recognize the mutual capability for

destroying this force. Control of the intelligence and the serious orders behind the delivery of force is now rising to that No. 1 position."

The Thompson-Rama Woolbridge laboratories will not be confined to developing such systems, but will work on various approaches to data processing, to machine translation of languages and to systems for airframe navigation and traffic control.

### Itsek's Plan

How does plan to fit itself into what it focuses as the market of the 1960s provides an example of industry thinking an adaptation to a rapidly changing technology—total sense of the problem.

Unlike many companies which consider 70-80 as an ideal military-commercial breakdown for business, Itsek sees a 70-30 ratio, but one that extends further than simple diversification.

• **Military business**, now moving about one-third of Itsek's total volume, would remain at that level ideally. Leghorn estimates the future military information technical market at \$1 billion, and it stands at a 5-10% share of that market for Itsek.

• **Commercial business** is sought as the primary source of funds to meet on a research-based company. Under this system the company then would be able



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If ever an organization was designed from the start for space system development and production, this one is.

Turned last August, Chance Vought's *Aeronautics Division* already has made flight delivery on a NASA contract to provide flight research vehicles.

For the future, four major lines of interest have been chosen: development of space research-type research vehicles, research payloads, including instrumentation and environmental simulators, manned space vehicles, and language studies to anticipate future needs.

That is a self-sufficient, self-organizing division. A few key posts are being filled now with men who can both mold the organization and direct its space programs. Five men are needed to fill these various positions:

1. **Senior Specialist for Navigation and Guidance Group.** Advanced R.E., Ph.D. preferred. Experience in stellar navigation and star tracking system techniques and in RF guidance and inertial navigation systems. To organize this area of divisional activity, handle conceptual design.

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3. **Aeronautics Staff Scientist.** Ph.D. preferred. To conduct advanced theoretical analysis and apply advanced technology in navigation and guidance, communication and detection, and aerospace controls.

4. **Guidance Systems Engineer.** Physics or R.E. (M.S. preferred). Experience required with stellar guidance systems for space applications and with analytical real equipment systems. To conduct guidance analysis.

To inquire in complete confidence, write:

J. R. Clark, General Manager,  
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SINCE 1925

to control its own destiny, its president believes.

Earlier in the development of the company, Leghman had estimated the company would need a minimum annual sales volume of \$75 million at the 70-70 business-commercial ratio to give a self-sustaining character to a research-based company. Leghman is still in search for a \$100 million sales volume to bring the company into maturity.

Incl. was initially financed two years ago by Laurence S. Rockefeller and his associates, a step which resulted two months for this venture capital group committed with aviation enterprises.

One is a step further back on the development curve of a company for an external. Because of a growing search for "growth" companies by investors, venture capital groups like the Rockefeller are finding it necessary to go into a company while it is in a more embryonic stage than it has previously performed.

The Rockefeller group provided most of the initial \$100,000 financing of the formation of the company in September, 1956, to Leghman. Dr. Arthur W. Tyler, like Leghman formerly with Fairchild-Kodak, Co.—and Dr. Herman M. Donald, dean of the Boston University Graduate School and former director of the company's physical research laboratories, following suit. The Rockefeller group put the company in touch with its experienced financial man, Jesse N. Coates, formerly with Standard Aircraft, who became vice president and treasurer. However, the company, operated with fewer than 10 employees the rest of last year.

### Investment Worth

An estimate described as "in the ballpark" puts the total Rockefeller investment in the sum of half a million dollars. At today's market prices of \$45 to \$50 a share, this investment on paper is now worth in excess of \$7 million. However, the Rockefeller are essentially locked in for a long period of years because any attempt to sell a substantial part of the interest before the company has firmly established itself would drastically knock down the market price. In other confidence provided by the Rockefeller financial book undoubtedly played a major role in making the stock so much more cost \$200 a share before a five percent split was authorized.

Early in 1955 Incl. acquired the physical research laboratories and staff of Boston University's major defense contracts completed with the fact that the laboratories was becoming involved in hardware programs led the university to discontinue the operation.

Next, Incl. acquired Viotron, a laboratory of high precision electro-mechanical equipment which was then in



### Vought Concept Upgrades Cockpit Environment

Prime goal of the Vought capsule concept is to improve the environment within the cockpit of future manned aircraft and spacecraft. This is imperative to keep up with the "State of the art," i.e., while aircraft capabilities are increasing rapidly, man's capabilities remain fixed.

Vought's capsule provides that stress comfort and freedom. Simplicity and maximum efficiency are its guiding principles. True contrasts with the 22 pounds of environmental and escape gear with which today's pilot frequently must burden himself. In long-range aircraft and in missions stretched by aerial refueling, this burden penalizes pilot performance. In poor flight testing days or weeks, such countermeasures would be solvable.

In the Vought concept, protection is in effect at any altitude and speed that modern aircraft can reach. It extends to the runway end, in the event of a ditching, even to water. Such survival equipment as rafts, clothing and supplies will keep the downed pilot safe and comfortable until rescue arrives—and extensive emergency communication equipment will hasten that recovery.

Environmental and escape systems are specialties developed by Vought. This division also develops manned aircraft, atmospheric missiles and autonomous apparatus. Other major interests are being advanced in the company's *Aeronautics, Electronics, Range Systems and Research Division*.

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### NAVY GIVES SAFETY A HIGHER CEILING

A new concept may enable Navy flyers to escape stricken aircraft as shown above. The pilot has triggered a shaped charge which sheared his cockpit free of the aircraft. Inside his parachute-borne capsule, he remains safe from windblast, biting cold and pressure. He breathes the same identity conditioned air that sustained him before ditching.

This tough bubble of life-sustaining atmosphere provides more than escape. It removes the need to increasingly burdensome personal gear. By allowing the pilot to stay clear of the cockpit, the concept is under development today in Vought Aeronautics, a division of Chance Vought Aircraft, Incorporated.

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### Morines Order Lockheed GY-1 Hercules

U. S. Marine Corps version of the Lockheed AN F-119B Hercules designed GY-1, will be built under a \$10,200,000 Navy contract at Lockheed Aircraft Co., Sunnyvale, Ca., plant. Preprototype are four AH-1H T36 helicopter. Range is 4,500 nmi. as

estimated financial circumstances. Primarily this was a move to acquire Western's aviation plant in William, Mass., now Bell's headquarters, to give the company the status with the military of a "reliable contractor." However, it brought with it Western's contacts with Hughes Aircraft Co. for electronic technologies for the Falcon missile.

This year Bell acquired Photostat Corp. of Rochester, N. Y., which is familiar as an important source of commercial business. It also acquired an R&D subject in Video, Inc., a company started by former National Aeronautics and Space Administration employees at Palo Alto, Calif., as an entry into the space field. Video now is studying a new type of plasma application.

### Selling Research

Part of Bell's business is the sale of research as a product—the second of the two trends noted in the Rockefeller group.

Bell does not represent the furthest venture in this direction since hardware plays a big role in Bell's culture and commercial value. It has just unveiled a broad-based model of a device for handling and moving small chips of film for information. Scanning can be done at a rate of 500,000 a second compared with 20 to 30 a second for some other systems. The entire system is called Indus and includes a feed-in system, a processor, and storage unit and a search selector. Its major advantage is that it will be

able to store graphic information as such, rather than requiring conversion of data to a numerical or coded storage system.



### Army to Test HU-1A Attack Capability

Development of Bell HU-1A turbine-powered helicopter's latest capabilities to include its use in the suppression on the battlefield will be tested by U. S. Army's Rocket and Guided Missile Agency at Redstone Arsenal and the Army Aviation Center at Ft. Rucker. Bell has fitted an HU-1A in shape with a missile rack extending from each side of the helicopter, permitting carriage of six French Mist 55-11 solid propulsion missile-controlled rocket weapons. The \$2.6M \$8.1M would be controlled by the target by the rocket's own self-defense mode of more than 3,500 ft. launch time was performed by the company under an Army contract.

concern, according to Rockefeller investment, Coughlin Corp. of America, which outlines Bell's administrative and but as far as no other connection, represents a much greater distance on the road to selling out, research. So does General Applied Science Laboratories, Inc., a Long Island, N. Y., group in which Dr. Theodor von Karman and Dr. Arthur F. von Karman Foundation are interested. This Rockefeller-backed group plans to stick with research as a business.

### Systems Approach

Bell is engaged around the systems approach in its primary field, which is information retrieval. (The name Bell is coined from the word information technology.) In systems like its Indus, it will use existing equipment where suitable kinds are available but will use its own electronics capability to develop new equipment that doesn't exist.

Photostat probably will be oriented more toward hardware. Its new data in various papers and chemicals and computerized development will call for production of specialized equipment.

In optics and photography, the company does good lenses and develops other hardware, but this operation is strongly directed toward research through not necessarily the sale of it. This organization tests radiation

quality of film for manufacturers. But a more typical example of what Bell means by "research-based" company is the company-sponsored study the video people are doing on photography in space.

Telegonometry—extreme light or cold—do not seem to present as severe a potential problem as does in a vacuum which might cause the crack in a material which might break the film. One approach being investigated is a non-optical, non-mechanical solution which would not be sensitive to radiation.

No specific application is involved now, but the possibilities for military or commercial use are evident.

Information retrieval is a field in which Bell has generated computer forms, which has brought Bell as a young company into conflict with Western Reserve University, one of the partners in Western Reserve's Center for Data Reduction and Communication Research has formed as projects in certain areas of the area, one of the more prominent in technology in cooperation with the American Society for Metals.

Western Reserve sponsored a conference last summer which included participation by Rumanian from the Soviet Academy of Sciences which is taking a strong interest in the problems of accurately abstracting and indexing for quick scanning is another the 11,000 scientific journals, 60,000 books and 100,000 reports being published annually.

Both Bell and Western Reserve talk of establishment of information centers at key sites where equipment for automatic storage and scanning could be maintained. Both are involved in the development of video for precise methods of coding information so that it can be stored in present types of equipment.

It was a National Science Foundation grant to Bell in this latter area that led Allen Kent, associate director of the Western Reserve center, to make changes of duplication before the Senate Subcommittee on Reconnaissance and Internal Operations last spring. The committee was holding hearings on a bill to establish a U. S. Department of Science.

The Bell program is an attempt to develop a language, called L-representation, that can be understood. This uses the terms from functional calculus to divide things into functions, which include properties and relations among things, and arguments, which are things having properties and things related.

Thus the subject "impaction of pollution by atmospheric aerosols" separation would be a function and pollution and atmosphere would be arguments. By assigning symbols to

each one, not only on the specific term but symbolized and stored, but a coding pattern can also be developed. Thus it becomes possible to characterize unrelated information that might be produced by the scanner in this sophisticated manner.

National Science Foundation developed its grant by pointing out that the proposal was somewhat for 17 and 18, but the reality between the two organizations still exist.

### Search Selector

Bell is using a search selector made by Computer Control Co., Wellesley, Mass. Western Reserve is working with General Electric in the development of the GE 154 selector in its program.

One of Bell's principal problems is the rapid growth it has attained and the recognition incentives have given this. As Langhorne said in a meeting of the

Boston Society of Scientific Apparatus on the subject of the stock price rise. "Let us use links that we have been surprised, distributed, spread and increased."

By discussing Langhorne's future of use and profit goals as being already been attained in fact, investors have, in effect, fixed a certain amount of pressure on the company to keep on growing—quickly.

This is an added strain on the core models associated with a company's use in accounting—especially when a management accustomed to operating in a smaller environment suddenly is forced to deal with more people, more money and more complex problems.

Thus Langhorne has told investors of the potential for the company because of its participation in new areas of technology and an commercial diversification, but he also has warned them to take a careful look at Bell because some of the same risks of funds apply to the company at its present stage.



### Indianapolis Computer Link Control Centers

Computer at Indianapolis, Ind., Air Route Traffic Control Center (above) has been fed into under equipment at Washington, D. C., Cleveland, Ohio, and Pittsburgh, Pa. Systems is International Electronic Machines Ramco 650 and is first to automatically exchange information with other Federal Aviation Agency centers equipped with computers. At left is Indianapolis main control room for air traffic controllers, owned at the Kansas City computer. FAA says it plans to retrofit electronic computers in about 30 other centers.



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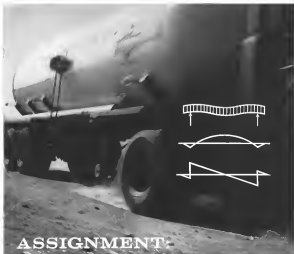
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## AERONAUTICAL ENGINEERING



**SUPERSONIC** model with conical nose is tested in the Langley 4 x 5 ft. open-jet wind tunnel. New NASA supersonic transport design concept eliminates need for a conical nose and uses a highly swept wing in place of the delta wing shown on this model.

## NASA Studies Supersonic Transports

By Craig Lewis

Langley Field, Va.—New supersonic design concept has been developed by the National Aeronautics and Space Administration that puts an advanced supersonic entry into the field of design possibilities discussed for supersonic transports.

Visually similar to the transport aircraft design evolved here at Langley Research Center the supersonic layout is considerably more complex. It incorporates both the conical and horizontal tail surfaces and has a thin, carefully shaped fuselage and a highly swept wing with engines poked in the wing afterburners.

A recent development, this super area rule concept often higher lift-drag ratios than those for the delta wing of the type used on the North American B-70 Mach 3 bomber, a wing similar to the designs in recent supersonic transport proposals. The B-70 wing design was laid down three to four years ago at a time when the new NASA concept did not exist.

That intense NASA contribution to transport design may be among its last in view of the sharply diminishing interest in supersonic research. With



NASA supersonic transport design concept involves conical combination of wing design and fuselage shape. Fuselage shape is critical in the wing area, and the pitch effect guarantees low pressure over the forward part of the wing area the fuselage to aid lift. The whole wing plan is designed to keep lift over the forward section of the wing where airflow is most favorable. NASA researchers estimate this design has about half the drag due to lift of the supersonic delta wing such as the one used on the B-70.



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space program identifying the bulk of NASA funds and energy, and with developing satellites, interest in new high speed aircraft aerodynamic research is boosted for major efforts in the agency which is increasingly emphasized (AVW Nov. 30, p. 26).

Exception to this trend is VTOL research, which will continue as a subthreshold program. Prospects of a hypersonic transport could be among the most persistent casualties of the budget. If studies had to pay for and conduct all of the basic research necessary to develop a hypersonic transport, economic considerations might kill it even before its feasibility is established.

Although it is visually similar to the transonic area rule layout, the new NASA supersonic concept produces a design that is "an entirely new approach, a further extension of area rule ideas," according to Robert Whitcomb, NASA's aerodynamic research manager and winner of the 1954 Collier Trophy for developing the transonic area rule.

Whitcomb told Aviation Week that the supersonic concept reached the point where it appeared feasible a year ago and that it has evolved into an efficient design within the past six months.

NASA's supersonic transport is still a research model, but it has moved into fairly detailed design. Whitcomb and several aircraft manufacturers are studying it, but he also cautioned that it is a complicated design and must demonstrate distinct advantages to appreciate the various design proposals to earlier supersonic transport planning.

In its present form, the NASA supersonic design is for a Mach 2.2 transport. An aircraft in this speed range can be constructed of fairly conventional aluminum materials, while a Mach 3 transport will have heating problems severe enough to call for titanium steel construction. The debate over whether to build a Mach 2 transport or jump all the way to Mach 3 is a genuine argument in the industry, and apparently only Lockheed Aircraft Corp. is committed to the Mach 3 approach in its

The question is crucial, since the market for a supersonic transport is limited—possibly 100 or so aircraft—well merited studies prohibit even the relatively limited number of entries now looking for subsonic turbojet transport orders.

Wing on the Mach 2.2 model is swept 75 deg at the leading edge. Sweep can be increased by increasing the wing area, and a Mach 3 version would have about a 75 deg sweep. In most of the wing design is determined by its shape. A swept spanwise profile, with an upward curve toward the



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## CASE HISTORIES

hinge and a downward curve toward the wing tip. Engineers are peddling an wing afterbodies and are being behind the wing structure for safety reasons. Intake ducts for the powerplants come through the main wing structure. This high sweep wing design is aimed at stopping shock wave formation, thereby minimizing drag and smoothing air flow. The leading edge is swept behind the shock wave generated by the forebody, and the wing fits in an area considerably down stream than is front of the shock wave.

Since the airflow is favorable for lift over the forward part of this wing design, the purpose is to keep it forward. Wing afterbodies are used to direct the airflow over the rear portion of the wing and keep the main lift forward. For the same reason, the large aft wing area characteristic of the delta wing is eliminated because it is inefficient. Whitcomb estimates the NASA swept wing has drag due to lift about half that of the B-70 type delta wing.

Fuselage shape also plays a key role in the wing lift characteristics. Whitcomb told Aerospace Weekly the swept wing is not superior to the delta wing by itself, but that it is superior when combined with the wing afterbodies and the forebody. The forebody has a long, sharp nose which tapers out to the point where the wing leading edge is joined, then is pushed over the wing root and bulges to its greatest cross section near the wing trailing edge.

one third chord point. Mechanics for the design are based on a pad which forces the outboard wing aftbody.

A Mach 2.2 transport using the NASA concept would be in the same 100,000 lb gross weight class as present intermediate range transport aircraft. Whitcomb describes it as an aircraft that would have about the same range as present jets, but one which would be much faster. This makes it a transcontinental and transatlantic one-day transport. Greater speed will require more power, and NASA develops some means of shortening takeoff roll for its supersonic design.

During the recent in-flight inspection test, NASA mentioned expected confidence that, despite discussions of rocket-powered transports, most air transportation will take place in aircraft that will cruise in the atmosphere powered by subsonic engines. NASA said it is continuing its emphasis on the search to advance performance characteristics of such aircraft.

Longer research charted speed versus elapsed flight time and pointed out that, among the high speed transports, the current subsonic turboprops operate close to the optimum speed for such short hauls at New York-Chicago, but as range extends to such distances as the New York-Moscow route, a supersonic transport would fit it in less than half the time required by current jets. Thus, the supersonic transport would produce a dramatic reduction in flight times over the long haul routes it would

fly, and NASA observed that, if they are built, supersonic transports will offer the largest increase in transportation speed ever made.

On a note as long as New York-Moscow, the hypersonic transport offers substantial time savings over the supersonic airplane, although they are not as dramatic as the gains from subsonic to supersonic. With flight times already cut to reasonable limits by the supersonic transport, the need for further time cuts might be sub-optimal by the very great expense and technical effort required when the time comes to decide whether air transportation will move on to hypersonic aircraft.

From its research, NASA has concluded that supersonic transports with flight efficiencies comparable to subsonic turbine transports appear to be technically feasible. Researchers said there are technical problems other than flight efficiency to be considered but that none of them appears insurmountable. This also pointed out that the "economics of supersonic" will play a large part in determining whether a supersonic transport ever goes into service.

Discussing its approaches to various drag problems with supersonic transports, NASA said wave drag can be measured by using long, thin wings and fuselage or by wrapping the wings back at a large angle. Reporting substantial reductions resulting from attempts to cut drag due to lift, NASA cited its new supersonic transport concept and the technique of flattening the



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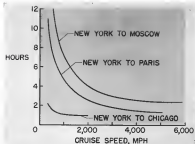
### Combined Fuselage

In contrast, the present fuselage cross-section with the maximum area rule is near the leading edge.

The fuselage, swept over the wing is a critical factor in the supersonic design. Indenting the fuselage aft of the leading edge, just forward of the pressure over the long forward arm of the wing was the fuselage. The fuselage is also cambered to produce lift forward and balance the aircraft. This eliminates the need for a canard.

Whitcomb originally wanted to carry passengers in the middle-rear area of the fuselage but found that some must be carried in the forward section for balance. He also has found that the rear section must be made larger and longer to accommodate more people in order to make the aircraft a practical operational transport.

Hornet's tail surfaces have been eliminated along with the canards. The wing is swept enough so that the tips are near the tail area, and glass can replace the horizontal tail surfaces, leaving only a vertical tail surface for directional control. The whole outboard wing panel serves as an elevator by pivoting around a fuselage axis at about the



NASA chart shows how flight time decreases as cruise speed increases over three major intercity routes. Curves show that there is little gain in time at speeds higher than 700 mph, between Chicago and New York and that time gains are small on the New York-Moscow route in speed gains above 2,600 mph. Hypersonic speeds require time premiums on the New York-Moscow route, but the gains are less dramatic than those between subsonic and supersonic transports.



top of the fuselage to produce lift more efficiently and help the wing in two approaches in five feet. The flattened fuselage approach has been adapted to the B-70.

Friction drag is another problem, and NASA warned of the need for extremely smooth surfaces on supersonic transports to minimize that factor. Whitcomb told Aviation Week several manufacturers are developing techniques for smoothing aircraft surfaces, and he pointed to the Conquest B-56 as an example of progress in this area. He observed that any supersonic airplane must be smooth if it is to have any range.

#### Hypersonic Research

Work on hypersonic transport research is in a considerably less advanced state than the supersonic work. NASA has matched the point of testing single models in wind tunnels, but the test results feasibility of such aircraft has not yet been established. NASA will study drag characteristics of various configurations, as well as problems of stability and control of complete vehicles.

Heating will be a severe problem with a hypersonic transport, and NASA researchers point out that temperatures in the rocket engines will be higher than those encountered by the aircraft itself. At Mach 6, they estimate the temperature in the combustion chamber at about 4,000°. Since these temperatures are beyond the capabilities of stainless steel, the engine will have to be made from a refractory material, possibly with ceramic liners in the combustion chamber and hot nozzles.

Even with exotic materials, NASA thinks a cooling system will be necessary.

One scheme involves preheating the engine cooling to allow the hot inner surfaces to radiate heat directly to free space. Alvin M. Smith, NASA's chief mechanical cooling systems will be needed for the engine and possibly the airframe.

Fuel can be circulated through hot areas to cool them, but the stored hydrogen fuel will break down at the temperatures expected so that another fuel would have to be used. Hydrogen would be good for cooling and as an energy source, but the aircraft would have to have a very large and bulky fuselage to carry enough of the very lightweight gas.

NASA has done considerable research in transient transport designs, but this work is almost finished. Whitcomb points out that researchers have reached the ultimate shape from the aerodynamic point of view. Some use of the transonic area rule concept has been made with the wing afterbodies on the Conquest 400, but this appears to be



#### A3J Utilizes High-Strength Steel Landing Gear

Mass landing gear of the North American A3J Navy attack aircraft utilizes Stress Steel, developed by U. S. Steel Corp., in steel for the outer cylinder, inner cylinder, fork and a turntable. The nose gear utilizes the outboard in its pivot and fork. The fuselage landing gear is operated pneumatically by compressed nitrogen.

little project that other designs will be produced using the complete concept with its shaped fuselage and with engines podded in wing afterbodies.

NASA estimates that these area rule features could increase cruise speed of current subsonic transports about 100 mph, considering only cruise efficiency. Such other factors as extra weight and flutter would have to be considered before overall performance gains and economic advantages could be assessed.

Plans to develop the Hovcraft Hovercraft commercially were announced by the sponsor, the National Research Development Corp., but financial backing for the project still has to be negotiated. Deputy Director Dennis Himmelman told Aviation Week. Discussions are proceeding with a number of industrial firms.

Immediate development of the craft is likely to be as the form of relatively small units not exceeding 100 tons which would be suitable for operating in undeveloped regions.

Designs have been completed, Himmelman said, and could be available commercially by 1965.

Inventor of the Hovcraft, Christopher Cockerell, said here recently that the American design currently being used is "all very primitive, but capable of lifting one man, but certainly not capable of going from A to B."

#### Admiralty Evaluates British Hovercraft

London—Sunderland-based Hovcrafts are under evaluation (AW Sept. 14, p. 30) by the Admiralty. The service is evaluating a three-day evaluation by British Admiralty scientists to assess operational potential of the vehicle.

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MODEL with 52 ft. wingspan and two J69 engines is used in jet flap research at NASA Langley Research Center. Test will be conducted with both half span and full span flaps.

## NASA Begins Advanced Jet Flap Tests

Langley Field, Va.—jet flap research is moving into a new, large scale test stage here which will provide more realistic simulation of conditions met by a target aircraft which might use the SFCU technique.

National Aeronautics and Space Administration is starting jet flap tests in its full-scale wind tunnel here at Langley Research Center with a 52 ft. wingspan model equipped with two Continental J69 engines. Use of the large, swept-wing model and the hot exhaust stream of the J69 will provide a more realistic test than the research with smaller models and cold compressed air NASA has conducted here in several years (AVW Oct. 22, p. 56).

Those latest tests are being conducted with the external flow type jet flap technique which uses engine exhaust deflected up over the wing flap to produce added lift and viscous take-off and landing roll. NASA has also explored the technique of installing several small turbojet engines in the wing to exhaust from the wing trailing edge over the flap to increase lift.

The external flow type of jet flap technique could be most readily applied to such current subsonic aircraft as the conventional Boeing T-07 and Douglas DC-8 and the military KC-119 and B-57. The new test series will provide more realistic data for possible application to these aircraft, although

#### Subsonic Use

it appears that the technique has been developed too late for use in the current group of large, subsonic aircraft. Model now in the full scale tunnel has the same general wing design and flap configuration as the earlier models previously used. Tests will be conducted with both half span and full span flaps, and researchers will study different gaps and distances between wing and flap to find the optimum wing flap relationship. Later tests will investigate tail size and position.

The two J69 engines, nominally rated at about 800 lb. thrust, are piddled under the wings and hinged so they can be pivoted upward to direct the exhaust flow against the bottom of the wing, through the flap gap and over the

flap. Later tests will study different gaps and distances between wing and flap to find the optimum wing flap relationship. Later tests will investigate tail size and position.

The two J69 engines, nominally rated at about 800 lb. thrust, are piddled under the wings and hinged so they can be pivoted upward to direct the exhaust flow against the bottom of the wing, through the flap gap and over the



WING outlines all of the J69 engines (left) have been modified to protect them from heat generated by long term jet flap techniques. Engines are tilted to direct exhaust stream up over the wing flaps. Flat exhaust ducts (right) are formed by joining several small exhaust tubes.



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### Sabrejet Used as Orpheus 12 Testbed

North American Sabrejet is being used as a flying testbed for Bristol Siddeley Orpheus 12 turbojet engine (AW Sept. 26, p. 37). Engine, which powers 8,170 lb thrust with afterburner, was developed as a second generation strike fighter powerplant.

top of the flap. In actual use, the exhaust stream itself could be angled to direct the exhaust flow upward from a fixed engine.

Bottom wing surfaces of the model have water-tunnel inlet-X panels in the area expected to see hot engine exhaust. These are to protect the wing from heat during tests which might run as long as an hour. In use, the exhaust stream would be deflected upward for only one or two minutes during landing and takeoff, and heat protection would not have to be as extensive as that provided for the model.

NASA has fabricated flat, fixed nozzles for the 19th to spread the exhaust flow and direct it over the flap. Several small tubes leading from the engine exhaust an flattened and joined to form the nozzle. This is less efficient than a single nozzle, but avoids problems involved in using large areas of sheet metal under high temperature.

In operational use, nozzle design would be a key factor in a jet flap system. The aim is to get the exhaust flow through the wing-flap gap over the flap and spread over as wide a span of the flap as possible. The high velocity air can provide lift and also induce circulation over the wing ahead of the flap. This calls for flat nozzle flaps to flatten and spread the jet exhaust sheet.

Control nozzles are designed only to shape the action for flap purposes, but operational design would have to consider cruise thrust efficiency, and then be careful, indeed, to the individual engine method. Nozzles would have to be designed for low drag losses to keep the low cruise efficiency low. Even with an efficient nozzle using the jet flap technique will mean trading some cruise efficiency for the STOL capability gained.

Earlier tests indicate the gain in STOL capability would be substantial, and present tests are being run to verify these results. NASA estimates from its calculations that a T-7 could cut its takeoff and landing roll in half with lift coefficients of five to four. Next step after the current model tests would be flight testing, but there are no current plans to carry the program into this stage.

NASA scientists have flown flight models with lift coefficients as high as 12.5, and the configuration looked feasible from the stability and control standpoint. A control jet in the case was required during tests at C-12. With

the jet flap technique, high circulation induces downward, and increased horizontal tail area would probably be required to maintain controllability.

Tests indicated that an aircraft could be trimmed with its horizontal tail up to about C-12, and that that point might be in some other technique would have to be used for trim. The caveat might be a better approach, but it has some tricky problems not present with a horizontal tail, and the caveat itself would also require a jet flap system. Directional stability is not considered a problem.

The external flow jet flap system could be modified to convert transport and bomber designs, to produce the desirable STOL capability calculated for it, but a number of factors involved in installing and operating it must be balanced before a final component and technical evaluation can be made. Loss in cruise efficiency from the flat nozzle is one factor, and the weight added by the nozzle and other hardware is another. Long term problems of heat and acoustic fatigue on the bottom wing and flap surfaces would probably require some structural changes and new materials.

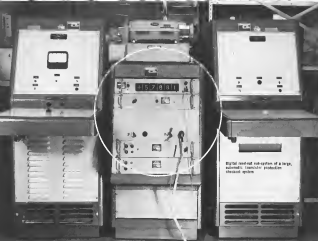
Now is a further consideration, since the exhaust stream is blown over the bottom of the wing and it would be seen under the aircraft. This probably wouldn't be a major problem because the jet flap would be used only for short periods after takeoff and before landing, and most of this time would be spent inside airport boundaries.



### Piasocki Platform Starts Yaw, Speed Tests

Airspeed and yaw indicator probe has been added to the Piasocki Y2-57 flying platform in initial phase of Army research program. Platform now uses a Turbostrut Airborne HE nozzle (AW July 31, p. 438), highest altitude to be 29 ft.

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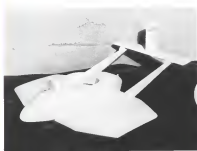
of comparable capabilities, have a wide range of inlets and flows, have no buzz, and are practically insensitive to vibration and shock. Note specific performance data and parameters. These Leonard regulators are now in use on many major machine systems and in ground support.



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Control System	Automatic/Manual Selectable Off and Position Indicator	Integrated Part of Major Business Automation System	Air Supply with Solenoid & Relief Valve, Relief Valves etc.
Control System	Air, Nitrogen or Helium	Air, Nitrogen or Helium	Air, Nitrogen or Helium
Pressure Range (Typical)	15-25 PSIG & 5 PSIG	200-600 & 5 PSIG	30 to 25 & 5 PSIG
Rated Pressure	2000 to 600 PSIG	3000 to 600 PSIG	2000 to 300 PSIG
Rated Pressure	6000 PSIG	4000 PSIG	6000 PSIG
Rated Pressure	2600 PSIG	2200 PSIG	7600 PSIG
Flow	6-400 SCFM	6-20 SCFM	6 to 35 SCFM
Leakage			
Rated Fuel		70 cc/hr (1000)	2 cc/hr (1000)
Leakage (Rated)	10 cc/hr (1000) (when shut off)	10 cc/hr (1000)	1 cc/hr (1000)
Temperature Range	-50° to +100°F	-50° to +100°F	-50° to +100°F
Vibration	ASME-B63.2, Type 2	ASME-B63.2, Type 1	ASME-B63.2, Type 5
Control Location	30 ft (10 ft)	20 ft (10 ft)	50 ft (10 ft)
Weight	3-6 lbs	3-6 lbs	1-40 lbs



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Wind tunnel model of a Vought general effort vehicle is electrically powered. Design involves use of a ducted fan aft of the pilot's cockpit. Air is sucked from a slot around under edges of wing for increased cushion and down trailing edges for forward flight.

Moscow-Kremlin press has issued another blast at Soviet businessmen who have refused to cooperate with the receivers of "three subsidiaries."

Last summer, the government newspaper *Excelsior* charged that officials selected by "persecution conservatives" were negligent in looking to carry through with work on a model ground-floor art festival in 1955 by Gonzalez Tuñón, a patronistic agency. Now, according to Latorre, responsible officials are giving the brush off to ideas introduced by Alfonso Santisteban, an auto-motive campaigner.

One of Simola's "flying automobiles" has "pockets" on the sides containing a collapsible helicopter rotor which can be mounted in a few minutes on the car's top. "With such a rotor in the car top," Ivaska explained, "the automobile can rise into the air and cross a river, where it will continue its trip on wheels. The rotor is easily disassembled and put back into the pockets."

"The *Rivista* paper said this drug of Serbelli's has been available since 1953. It is hard to explain why even an experimental model of it hasn't been built. Obviously, somebody's inertia is making itself felt."

Suction has also been working on a ground-effect flying automobile "held up by two columns of air." Suction rings "up to 14 inches in diameter" would be mounted on the car's roof.

"Three-bladed propellers driven by two automobile engines will suck in and eject it powerfully through openings in the floor," Ingersoll said. "Three strong air streams are generated which lift the automobile off the ground and force it to rise in the air."

Special system, which can give pre-determined direction to an stream, will provide directional control and will turn the automobile any way desired."

Pana-Linco's first aircraft carrier, the 22,000-ton *Clematis*, has begun its initial sea trials.

Sited for service in 1962, the center will be manned by a crew of 2,500 and will carry some 60 aircraft, mostly Douglas B-57C, F-4E, F-105, and F-106.

The *Clemsonona* has a flight deck some 775 ft in length and 135 ft wide. A curved landing deck stretches about 500 ft off from the regular flight deck at an angle of 8.7 deg.

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PRODUCTION line at Beech Aircraft Corp.'s Plant No. 2 at Wichita emphasizes the sharp upswing in business flying.

## Beech Aims at \$60 Million Sales Year

By Ervin J. Holban

Wichita, Kan.—Calling 1960 "a year of decisions" during which Beech Aircraft Corp. will lay the foundation that will determine its future is the philosophy but conservatively tough decade ahead, Vice President Commercial Sales Louis Greiner set a goal of more than \$45 million in factory billings for business aircraft and parts before some 150 distributor and dealer representatives attending the company's annual sales meeting here.

Achievement of this record goal will mean that, as companies last years unaffiliated businesses will spend a total of some \$60 million for new Beech aircraft and equipment in 1960—more than double what they purchased from the aviation industry a decade before. In the case of the hardest hitting sales talks he has yet delivered, Greiner said there is no sign that these will be any

exceptions, but pointed out that there are other people in the business and nothing will come easy. To meet the goal of "\$60 million in '60" is going to take an increased sense of responsibility on the part of the entire sales organization and greater enthusiasm to sell all of these new aircraft," he said.

He emphasized the "all" by indicating that there will be too many people who have their "favorite" airplanes on which they spend the major portion of their sales effort to the detriment of other models. And he also emphasized that to increase sales will mean that there will have to be "more of you—more salesmen and more dealers."

Greiner's optimism that Beech would meet the goal of \$60 million in 1960 accrues to not on solid ground—although in the final analysis it will be the field sales force that will provide the proof. There are three factors in favor of the company's distributor-dealer organiza-

tion this coming year to a greater extent than ever before.

• **Low inventories** of 1959 models, which give the dealers a good start in promoting the 1960 models. Bonanza inventories, for example, are less than half of what they were a year ago, Greiner noted. Super 15 inventories are, almost gone, he said.

• **More than 35%** of the company's present manufacturing backlog of more than \$24 million worth of new airplanes ordered by dealers has already been sold to customers sight unseen. Beech this year, with the inventory situation looking favorable, held a crutching last August with top distribution and dealers to bid them in advance of the annual sales meeting so they were able to start their sales campaigns early and tap into prospects who might have bought competitive makes in the interim.

• **Major improvements** in its models, in response to dealer requests, should co-



TRACK-MOUNTED seats on Beech Twin Bonanza (left) are a sales feature this year; forward view shows baggage storage area. View of plane's cabin door is at right; its use illustrates the need for climbing on wing and over seats, as in past years.



LARGER tail on 1960 Beech B35 Turboprop is one of center of gravity shift brought about by lengthening the cabin. Seats are track-mounted and backs can be lowered to provide beds. Electrical panel is at left side of cockpit, providing more panel room.



REVISED instrument panel in the Beech B35 is shown at left; auxiliary fuel switch has been relocated in the master, near the throttle. Super wings beyond the B35. Primarily a style change, the type improves aerodynamic flow.



## 21 U.S. missiles rely on Raytheon electron tubes

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1. **Leucostic**, Army, Ground-to-ground, Prime contractor: Martin
2. **Missile**, Air Force, Subsonic to supersonic, Prime contractor: Martin
3. **Nike Hercules**, Army, Ground-to-air, Prime contractor: Westinghouse Electric
4. **Neptune**, Air Force, Air-to-air, Prime contractor: Hughes
5. **Superdagger** (SAGE), Navy/Air Force, Air-to-air, Prime contractor: Philco General Electric
6. **Red Bull**, Army, Ground-to-ground, Prime contractor: Chrysler Corp.
7. **Tyrone**, Navy, Surface-to-air, Prime contractor: Convair
8. **Tung**, Navy, Surface-to-air, Prime contractor: Bendis Aviation
9. **Atlas**, Air Force, Ground-to-ground, Prime contractor: Chrysler



10. **Titan**, Air Force, Ground-to-ground, Prime contractor: Douglas
11. **Scorpion**, Navy, Air-to-air, Prime contractor: Raytheon
12. **Sagebrush**, Army, Ground-to-ground, Prime contractor: Sperry Rand
13. **Shack**, Air Force, Ground-to-ground, Prime contractor: Northrop
14. **Shack**, Air Force, Air-to-ground, Prime contractor: McDonnell
15. **Shack**, Army, Ground-to-air, Prime contractor: Raytheon
16. **Titan**, Air Force, Ground-to-ground, Prime contractor: Martin
17. **Bullseye**, Navy, Air-to-ground, Prime contractor: Martin
18. **Sage**, Army, Ground-to-air, Prime contractor: Westinghouse
19. **Scorpion**, Army, Ground-to-ground, Prime contractor: Philco General Electric
20. **Neptune**, Air Force, Ground-to-air, Prime contractor: Bendis
21. **Jupiter**, Army, Ground-to-ground, Prime contractor: Chrysler Corp.



**DISPARITY** Bonanzas, at left at \$19,995, will put Beech into a market held by Piper with the Comanche and Seneca with the Model 238. Cessna's old Delmarz costs with a simplified interior and instrumentation (right)

with the sales force to overcome objections that they had lost their sales in the past. New Twin Bonanzas, for example, this year have an integral air flow providing easy access to the cabin and individual track-mounted doors. The company is holding the 1999 price on several important models, such as the Bonanza and Travel Air, even with the addition of considerable improvements.

• **Larger model line** in 1990 adds the new midstream twin Quicksilver between the Super G18 and the Travel Air, and the four-place Delmarz at the lower price end of the scale for those who did not feel ready to step up to the Bonanza price range just yet, making it possible for the organization to tap wider markets than ever before.

Bell, however, emphasizes quickly pointed out, these plan factors. He adds that the distributors and dealers only have to order airplanes and sit back expecting them to sell themselves. Competitor Bonanza owners and Piper in going to be heavier than ever before (AW Nov. 2, p. 108; Nov. 9, p. 118) with all companies setting high sales goals, expanding sales efforts and offering larger model lines. This competition has already made itself felt in the sales charts, as Greiner pointed out in the decade 1990-1999, the business aircraft manufacturing industry's volume has shot up since 60%, while Beech growth has been 600%.

In discussing the growth in business volume available in the distribution, Greener noted that in 1999 the company guided over \$8.6 million in domestic to domestic outlets, compared with just over \$2 million in 1995 and just over \$5 million in 1993. In the 1990-1999 period, Beech discounts its distributors (and increased since 1997), he noted, while the company's total business has increased since 600%. In

1999, discounts to domestic distributors included approximately \$1.1 million on the Bonanza, \$1.5 million on the Travel Air, \$1.5 million on the Twin Bonanza and approximately \$2.5 million on the Super 18. And on the basis of distributor-dealer financial statements, those sales and service outlets realized better than 41% profit after taxes, with a net of better than 12% before taxes, based on gross discounts including sales of airplanes, parts, service, fuel and all other income.

#### Financial Statements

Importance of the distributor-dealer financial statement was underscored by A. R. Bell, who heads up Beech Aircraft Corp., the company's wholly owned financing organization. He told the listeners that their monthly financial statement was one of the most important things they had for planning their future, because it spotlights a business' good and bad points.

Talking up the financial statements from Beech distributors, he noted that only two of five showed that those

outlets were making money in all departments and not as much as they could or should.

A detailed statement may tell the distributors that he is losing money in his service department—but not where. They take usual expense control, especially on fixed expenses, which are not easy to manage. He pointed out that personnel should save 30-50% of fixed expenses, so the distributor and dealer have to keep track of how these people are being used, how they are being managed and how they buy. Good organization is needed to make sure that high-priced mechanics are not doing line or porter work, he emphasized.

Marketing Service Manager, Paul Allen pointed out that a lot of money is being lost in sales efforts in the new line Bonanza spare parts orders. In 1999, Beech delivered some \$49 million worth of spares to domestic and export distribution, yet only 27% made their purchases on a monthly stock order, which provides them with an extra 3% concession.

Boosting the sales representation on financing, Bell noted that in his opinion money is about at the peak of its tightness and that interest rates will stay about where they are now for a long period.

Banks, he contended, will not seek to move new customers on loans and more will probably seek to keep down their credit loss operations.

He pointed out that in making a sales contract, the Beech representative should get into the lease and finance aspects of financing an airplane to the customer in his initial discussion. Many companies already are aware of equipment leasing, he noted—some 74% of truck registrations in this country are on a lease basis, and automobile registrations are higher—and customers will be receptive to discussing aircraft equip-



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**LARGE** side windows and two-engine dash should mark the 1990 Super G18. Side windows incorporate a large storm panel.



ment present on the line.

The particularly customized solution against financing out airplane financing. Any outside interest may cause the sale to be lost—hence, he said, this discounting the customer from extending his loan credit by leasing a plane.

Boech Acceptance Corp. has financed more than 540 million worth of business aircraft, numbering 1,145 units, since it started operation in 1966. Bell reported. Those included 245 airplanes financed on actual loans, 119 on lease deals and 740 Boech planned to enable sales centers to maintain deconcentrated lines.

Additional aids for the company's field force will include the use of several recently represented. Tony Gillespie, who will work out of the factory with field salesmen in adding them to local sales to large fleet operators. Gillespie has made a detailed study of some 15 large business aircraft fleet operators beyond planes they have, where they have them, how planes are scheduled, how spares and maintenance are handled, operating and fixed and variable costs to provide necessary background on what information is needed to close the sale with a big operator. Gillespie will be on call to distribution centers when they need expert advice on doing transportation studies for that market.

The company is also providing specialized consulting for distribution and dealer who are thinking about expansion programs to help them in developing new layout, architectural design and airplane efficiencies in use of space.

#### Aircraft Lines

The company's 1966 business aircraft line is the largest it has ever had available, with seven versions of six distinct types. Highlights of the 1966 lineup are:

#### Bonanza Capability

Widest, kin—Stinson delivers flight at 2,775 mph in 6 hr 20 min in a 1960 Beech M35 Bonanza from the factory to the West Coast for the close of an annual sales meeting, late points up the performance of modern single-engine business aircraft.

Charles F. (Chuck) Auer, Aero Sales & Service, Inc., Farnam, Calif., a dealer for distributor Narco Aero Sales, said, made the flight at 12,900 ft. The Bonanza M35 Bonanza from the factory to the West Coast for the close of an annual sales meeting, late points up the performance of modern single-engine business aircraft.

• **Two-Bonanza** is available in two models, the D150, which has 240 hp, fuel injection supercharged Lycoming O-360-180 A1A6 engine and sells at a base customer list price of \$95,500, the D300, which has the high-compression 285 hp Lycoming O-360-240 G1D6 engine and sells at \$101,000. Except for performance and performance, the airplanes are similar, both feature the new integral airframe door on the right side just behind the wing and passenger door into the cabin, and reinforced track-mounted doors which provide a center aisle for easy access to various seats. Boech has dropped the floor of these airplanes approximately four inches, providing considerable extra head room. Fixed or retractable lightweight chair can be lowered to provide deeper seats, or a new lightweight couch can be installed, providing more places. Couch can be removed or installed in approximately three minutes. Other improvements include a new pilot's seat with vertical adjustment, flush-type fuel tank vents under the wings for better wing control, dual fuel pumps on the cabin heater system to increase its efficiency, squared wingtips providing improved lift efficiency and improved low speed stall characteristics, and addition of the new lightweight Goodrich deicer boots which are approximately 65 lb lighter than previous models. Gross weight of the D150 has been increased from 7,150 lb to 7,300 lb at a 40-lb increase in empty weight, giving the airplane a useful load of 2,200 lb. Bill Quinby, new Two-Bonanza sales manager, explaining Two Bonanza, said he believes there is a national potential of 141 Two-Bonanzas in 1966, compared with 129 in 1959.

• **Travel Air B55**, lightweight four-seater, will list at \$51,700 in its basic configuration, same as the 1959 model. In spite of considerable improvement in the cabin area which provides an additional 19 sq ft of cabin space for a pair of 17 sq ft, giving ample room for a fifth seat. Seats are also heated, mounted and have built-in reclining backs. Instrument panel has been revised, is getting electrical switches on a separate panel on the left side of the cockpit, window area has been increased to permit viewing rear windows in a row. For improved grouping and there is also more room for audio. Weight increase changes as a redesigned tail group added 19-lb, 100 sq ft to the basic empty weight, and a new, new except character control stabilizer with integrated landing on the dorsal fin. New tail no longer creates drag, loading of the airplane and also takes out the earlier weight sensitivity feeling. New wing flap uses 41 in. under the pre-



## BIG news in electronics for vibration testing

One of the world's largest vibration test systems was recently shown by MB to the Society of Professional Engineers. It featured an electrodynamic shaker of 20,000 watts, full range output, a 100 KW high fidelity power amplifier of advanced design, and fully integrated electronic controls for complete motion tests.

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- First application of FFT recording technique
- First to achieve low distortion in big range of active analog computers
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- First use of regulated input
- First use of regulated input

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## MB ELECTRONICS

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## Civil Aircraft, Engine Shipments

Shipments by Month Manufacturing Complete Civilian Aircraft and Engines for Civilian Aircraft

Item	1999 September	YTD Jan.-Sept. 1999
Complete aircraft, total airframe weight (total 100 lbs.)	1,772 1	16,242 3
By weight of plane:		
Under 5,000 lb. airframe weight	do	406 1
5,000 lb. airframe weight and over	do	1,322 9
By number of planes:		
1- and 2-place	do	392 3
3- and 5-place	do	1,380 9
Over 5-place	do	
By total rated horsepower, all engines:		
Under 100 hp	do	309 3
100-399 hp	do	1,459 9
400 hp. and over	do	1,412 9
Aircraft engines:		
Reciprocating	Number	866
Gas turbine	do	90
Aircraft engines, total horsepower		
Reciprocating (total 100 hp)	316 9	1,940 3
Gas turbine	do	94
Complete aircraft	Number	422
By weight of plane:		
Under 5,000 lb. airframe weight	do	229
5,000 lb. airframe weight and over	do	36
By number of planes:		
1- and 2-place	do	240
3- and 5-place	do	183
Over 5-place	do	49
By total rated horsepower, all engines:		
Under 100 hp	do	161
100-399 hp	do	161
400 hp. and over	do	71
Value of shipments of complete aircraft and parts, total (total \$1000)	32,732	496,673
Aircraft, total	71,540	467,339
Under 5,000 lb. airframe weight	do	7,469
5,000 lb. airframe weight and over	do	64,043
Aircraft parts	do	7,792
Value of shipments of aircraft engines and parts, total	14,760	122,316
Aircraft on engine:		
Reciprocating	do	3,337
Gas turbine	do	120
Engine parts	do	13,443
Modified engines (Gleason 5,000 lb. airframe weight and over)	Number	220

3 = Withhold to avoid disclosing figures for individual companies. Data prepared by Bureau of the Census, Industry Division, Aircraft & Equipment, compiled from 23 companies operating 22 plants producing complete aircraft and seven engine companies operating seven plants.

vision type, keep stall speed at 70 mph. Despite a gross weight increase of 100 lb., useful load is approximately 35 lb. higher. The airplane can take the new Goodrich boost decaying system. Airframe fixed back for propeller is located in nose baggage compartment.

• Debonair Model 33 four-place, which will sell for \$19,995, is designed to compete with the Cessna 310 and Piper Comanche and is in the market area in which Beech sees a volume of some \$15 million over the next two years for this class airplane. Formerly a Beech Bonanza airplane, the company has simplified the interior and equipment, put smaller wheels on the airplane and used the 225-hp. Continental IO-374 fuel-injected engine to get the price down. With this powerplant and a Hartzell constant-speed hydraulically-controlled propeller, the Debonair has a gross weight of 2,900 lb., useful load of 1,170 lb. and a high speed of 195 mph, with cruise speed being 183 mph at 75% power at 7,000 ft. and 180 mph at 61% at 11,000 ft. Service ceiling is 19,840 ft. Fuel capacity, standard tanks, is 49 gal., with auxiliary tanks giving 68 gal. usable fuel. Maximum range is 1,170 mi. compared with 813 mi. on standard tanks. Ranges are at 143 mph (45% power) at 10,000 ft. Airplane can carry 270 lb. of baggage. Type certification was done to satisfy category.

• Super G48, which is the company's seven-to-eleven-place "honey bee," that you sell at a base list price of \$125,000, up \$3,800 over the 1999 model. Major improvements have been in the cockpit area, a new two-piece windshield, right in the middle by a center console strip providing considerable increase in visibility. Extension of overhead baggage pockets added additional baggage. Radio pods are adjustable 24 in. and a new control lock has been designed that can be engaged into the panel from a starting position. Larger side windows include an operable stone panel, window can be jettisoned for emergency exit. Instrument panel has been redesigned so that all side windows are limited across the top, the only combined item being firing switches for Jeppesen General JXTD radios, which can be mounted in the nose of the engine nacelles as optional equipment. Another feature is interior-mounted "see light" located above the landing edge of the wings. Oxygen bottles, formerly located behind number 5 seat, are in the cabin, now are located in the lower nose on the left side for easier servicing.

Super 13 Sales Manager Gene Miller noted that 68 units were sold in 1999 at a total customer list price of \$130 million—Ohio Aviation Co., Vanland, took delivery of 11 airplanes, the all-time record since the airplane was introduced. In all, nine distributors made

from 1934 to 2000 over their quota on this airplane last year.

Miller cautioned distributors on taking on too much workload in regards to new installation on the Super 13, pointing out that the factory now has set up a custom order shop that could free distributors of the need for being up capital in such facilities, and also closes the need for holding the airplane up for a month to six weeks after delivery to the distributor prior to handing it over to the customer fully equipped. He noted that one distributor he noted had some \$750,000 worth of sales inventory. Under the new arrangement, the distributor commission on a factory-installed order is 100% profit and he also gets a commission on the labor. Miller cautioned that installation at the distributor's base "each provides a 6.7% profit."

• Bonanza M35 five seat is offered at the same \$25,100 price as last year's K35—Beech stopped the letter "L" this year to avoid confusion with USAF—Army use of this suffix to denote liaison aircraft. New major changes mark the four-place, which is now in production for 11 years during which time 6,161 have been delivered. Super aircraft have been added and instrument packages, placards and decals are quite white for easier readability. Aeroliner had pump switch has been moved to the center of the instrument panel near the throttle. The company sold 413 K35 Bonanzas last year, 31 more than the previous year in spite of a \$1,000 price increase. Sales Manager Steve Henshaw pointed out, with us of the company's distribution selling 10% of the total. Of over, Gene Henshaw sold last year, one ten cent off with the extra cost making it a five-place.

### Sales Leaders

Hennes was paid in the company's distribution and dealers making high sales volume last year. "Based on controlling performance on all four models were Coffey Car Flying Service, Alton, N.Y., and Long Aircraft, Omaha, Neb.

Chief for parts administrators for three models were Jack Adams Aircraft Sales, Memphis, Tenn., Alton Aviation, San Antonio, Tex., Atlantic Aviation New York Division, Teterboro, N.J., Atlantic Aviation Wingright Division, Del., Garber Aircraft, Denver, Colo., Elbert Flying Service, Decatur, Iowa, Ohio Aviation, Vanland, Tappan Aircraft Sales & Service, Kan., Tulsa Distribution, Tulsa, Okla., and Roscoe Turner Aeronautical Corp., Indianapolis, Ind.

Eighteen domestic distributors joined the Beech Milburn Dallas Club Alaska Aviation, Atlanta Aviation New York, Atlantic Aviation Service, Philadelphia, Pa., Butler Airplane Sales, Rockford,



Deep in the heart of every every business, the Statham Instrument Co. is the Statham Instrument Co. Of more than 40,000 parts in stock, there is no doubt that it is the Statham Instrument Co. Without them, it would be difficult to find it impossible to determine component reliability or to record the functional performance of the engine in space.

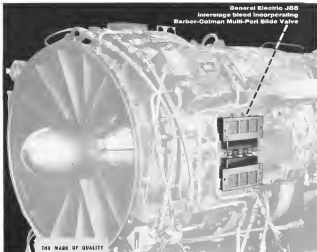
Typical of these rugged instruments is Statham's new 300-millivolt high output precision transducer that permits direct measurement of a maximum to low level voltage excursions oscillators. This 30-volt series, designed for sophisticated instrumentation, is fully described in Data File AW-208-1.

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Characteristics of Barber-Colman multi-port slide valves are as follows: Maximum temperature — 430°F. Maximum pressure — 60 psig at 630°F. Ambient temperature — 65°F to 350°F. Total leakage — 1.50 lb/min at 60 psig and 630°F.

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H. Casals Aircraft, Carlin-Carr Flying Service, Elliott Flying Service, Froyer Aviation, Lansing, Mich., Gough Aviation, Van Nuys, Ohio, Tuller Aviation, Racine, Tenn., Aerometrical Corp., and Youngman Airways, Ohio. Two export distributors having attained \$1 million in sales last year are William C. Morales & Co., S. A., Caracas, Venezuela, and Will L. Smith S. A., Buenos Aires, Argentina. Named, outstanding dealers were Central Flying Service, Little Rock, Ark., Waltham Flying Service, Cedar Rapids, Iowa, Aero Sales & Service, Fresno, Calif., Illinois Range Aircraft, Inc., London, England, Service, Lindbergh N. J., and George H. Bailey Co., Ft. Wayne, Ind.

## PRIVATE LINES

Breacher in Lockheed Aircraft Service's conversion of Douglas B-26 to pressurized version for business travel is available from LAA, one of general sales managers, Oakridge, Calif. The B-26 will seat 10 and provide cabin pressure equivalent to 4,000 ft altitude at 21,000 ft. Normal range is 2,500 mi.

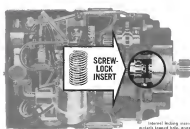
Italian Aeromobili Register reports that on Oct. 31 there were 901 private planes registered in Italy. Of these 469 belong to the government, 170 to clubs, 60 to various transportation companies, 44 to clubs and 26 to aircraft manufacturers.

Two Convair 440s as well as General Motors will be referred to engine engine interests in AirResearch Aviation Service Division of the General Corp. job also includes overhaul, fuel tank and exterior painting.

University of California announced Milton D. Miller estimates that 19% of the state's three million acres of grain and hay crops now are sown in aircraft. California farmers have hired 121 firms flying 3,188 planes to do the job.

Boeing B-2 helicopter will be distributed in Michigan, northern Indiana, northwestern Ohio and northern Illinois by Aero Enterprises, Inc., Midway Airport, Elkhart, Ind. M. L. Allen, Aero president, said the firm has sold two B-2s and has orders for another three. One B-2 is available for demonstration.

Baker Aviation has acquired Skimmer, Inc., based at Chicago's O'Hare Field, and will operate the company in a subsidiary Skimmer, an FAA-approved repair station, licenses Baker's 10th fixed base operation.



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Established 29 years

## Health

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## Present Position

World's largest producer of components for flight

## Experience

After years of experience in the engineering and manufacture of ready-to-install power packages, Rohr today is widely diversified in many fields of structural flight components. For instance, the design and production of such major components as fuselage sections, jet pods and struts, empennage assemblies, flap tracks, missile racks, wing leading edges, etc. Perhaps even more important is Rohr's leadership in the development and manufacture of stainless steel honeycomb sandwich panels, and advanced research in the field of practical usage of exotic metals.

## Reason for these openings

Rohr is selecting successful professional and administrative personnel to join its highly-regarded team.

## Business References

America's major aircraft companies

## Availability

We are available for interviews whenever it is mutually convenient. Please forward details of your education and experience to Mr. J. L. Hubel, Industrial Relations Manager, Rohr Aircraft Corporation, AWC-3, Chula Vista, California



after the aircraft became airborne. Another witness saw the flames immediately thereafter and stated that as the aircraft passed his position, following a side view of the forward side of the nacelle, it was his impression the flames were coming from the right (No. 1) PRT (power recovery turbine) exhaust outlet. Both of these witnesses were qualified mechanics and stated the flames were abundant. They described them as intermittent and a dirty orange and color looking toward along the nacelle area and visible even when viewed into the sun.

A few seconds later, when the aircraft was near the west end of the runway and about 150 ft above the ground, flames burst out of the nacelle area and viewed from the rear seemed to come from and surround the aft nacelle area. Two witnesses located on the opposite side of the nacelle, but not yet positively similar and then flames clearly after the aircraft became airborne. One stated that when viewed from a quartering rear position the flames extended below and to the rear of the nacelle. When other witnesses saw the smoke and flames about this time. Most agreed the gray-white smoke was observed first and became heavier as the aircraft continued, then, when the flames appeared they were immediately visible in the smoke. Of all these witnesses, none could recall the leading gear position as accurate to suit the No. 1 propeller was stopped. Several explained this was because their observations were almost instinctively tied to the smoke and fire.

In the Consolidated Cape Rock turned left as soon as possible to establish a base leg for landing on runway 9R, the parallel runway to 27R in the opposite direction of takeoff. The stated that the aircraft could not exceed 140 kt, the altitude did not exceed 400 ft, and the pattern was in place in position. He also estimated the first Thrust discharge was before the first left turn and the second was shortly after this turn. The leading gear was engaged during the left turn in final approach and landing flaps were extended shortly thereafter. Both operations were accomplished smoothly. The opinion and the breakdown were smooth and very close to the approach end of the runway. One and that through the rollout moment came breaking rapidly "baked out" and became as effective. All four distinctive and pulled into critical stages, at which time the aircraft slipped to the left. About this time it was learned the No. 1 engine had stopped and engine which started to regenerate. Secondary heating was initiated but also quickly failed not although the auxiliary hydraulic pump and manual power were engaged. It was also noted the primary and secondary hydraulic quantity indications were out.

With the partial backup available, some reverse thrust and second rolling distance, the aircraft slowed appreciably but did not stop until it crossed the end of the runway about 100 ft. Then the right main landing gear collapsed.

From various positions ground witnesses, who saw the flight from the first left turn to landing, it was established that flames were visible most of the time in the aircraft progressed through the pattern. None saw any part fall from the aircraft in flight. The fire became much worse as the



## Mi-1 Helicopter Competes in Show

Steepest pilot A. D. Ivankov enters an "obstacle" climb and landing in an Mi-1 helicopter during the second annual All Union Helicopter Sport Competition in Turkmen. Continuous on left side, left of cockpit, is an auxiliary fuel tank.

final approach and during the landing roll, flaming metal fell from the aircraft and flaming fuel poured down the main gear into the runway leaving a path of fire. One witness said that on final approach the No. 3 propeller was turning slowly, another said it was stopped. A photograph taken during the ground roll showed heavy flames pouring out of the aft nacelle area behind the evacuated main gear strut and passing the leading edge of the wing above and below the tips.

The three witnesses prepared for rescue evacuated before the aircraft stopped, entering passenger to see the left side and to remove their shoes and glasses before using the emergency slide chute. The main cabin door was opened and the chutes hooked up while two cabin passengers left the cabin through window exit 11-A. At a request from Stremmen, Thorpe they came to the cabin door, and held the handles at the emergency slide chute for the others to slide down. The others also used the chute with Capt. Rock last after a final check at the cabin. One cabin and partially disabled passenger received assistance to

his exit route condition during the evacuation. Though none of the crew could estimate the evacuation time, the rapidity and efficiency described by passengers and witnesses indicated it could not have taken much more than a minute.

The Delta County Post Authority airport emergency rescue and firefighting equipment interrupted the aircraft from a shortening runway (17-11) before it stopped. After learning that all occupants were safely out of the aircraft, the emergency personnel began to fight the fire, which was not extinguished for approximately 10 min and not used systems, was recovered from off airport fire departments from Marine Corps, Springs, Idaho, and Oak County. As a result, a part of the accident investigation and public hearing was devoted to determining what equipment was available at the rescue and firefighting department, the capabilities of the corporate, and the tactical manner in which it was used to fight the fire in this accident.

From independent witnesses of the Airport Fire Department it was learned that flames were seen in the principal firefighting





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Examination of the failed roasting rods showed all except No. 10 were broken off about six inches from the piston pin. The No. 10 rod indicated a splitting

The front left and right wheel well doors were inflated away from a consider-able portion of the leading edge and lower area of the right door and a smaller portion of the leading edge and lower area of the left door. Examination of the right door remaining structure showed that molten aluminum casting material had impinged as shown on the right surface of a vertical member of the right front door located about opposite the secondary fire shield that divides lines 3 and 3A. A study of the photograph of the aircraft during the test-

The same size 3 and 4 engine fuel lines for the main air and mechanical higher lines, the top of the fanfold cannot have been used as otherwise the associated fuel filter and fuel tank selector valves to full flow. Of these the No 2 filter fell first, before the fanfold stopped the others were found as the ground below their normal positions. Except for the No 2 selector valve, which was closed, the others were fully, or partially open. The emergency fuel selector valve located in stock 1 was found in the open position as were the hydraulic and oil valves associated with the emergency shut off system.

The large chambers they had recovered

Because of the considerable positive evidence most of which has already been mentioned, the authors conclude that, of the models, the concentration model is the most probable that in an unstable column there has occurred a significant increase in the concentration of the fuel. This is further thought that the Brazo then entered the earth, igniting the fuel, thus causing the fire. This possibility can then be ruled out because the model requires that the fuel weight increased whereas our experiments data have highly qualified point of the engine materials. The authors also note that the engine was from the Laidlaw Laidlaw Corp. and the propellant, unless Air Force. The possibility on the discussed by a highly recognized expert in the field of engine materials, flames and combustion under which flames can be ignited is a light.

In summary, it was the testimony of the witnesses that the engine was ignited during an engine failure of the aircraft that occurred it would be reasonable to expect some report of it to be heard by one of the witnesses. The witnesses were able to be produced by the court. The engine was learned about 5 to 6 miles. It was used and 5 to 6 below the Navy. It was not a recent case. The amount of the engine was not a significant one. The engine was learned about 5 to 6 miles. It was used and 5 to 6 below the Navy. It was not a recent case. The amount of the engine was not a significant one.

number of the helix. For example, if patients were born out of their cylinders, they could freely pass into the cylinder through the lower helix and into the next one.

The common thread was that, in almost all cases, the fire spread, spreading the potential for a small fire to become a major fire. The fire spread through the atmosphere through the engine breather tubes. Obviously, both situations could occur simultaneously. The authors stated that excepting one or both situations it would not appear an exhaust flame which could ignite fuel lines in the vicinity of the nacelle. The explanation for the fire in the nacelle was, in fact, the same. One instance of fuel being forced into the engine and from the breather to the common chamber broke, or leaked, producing a variety of other engine troubles but there was no fire, excepting the one mentioned, where a nacelle fire occurred during such difficulty. He concluded that in his opinion, a further element must have been involved in the fire, such as a fuel line pool, or a fuel system specific.

To date and show the effect of oil from into the exhaust system, the Control Wight Corp. ran tests for the Board. Conducted in a test cell, the tests were made with a working oil at 100 degrees Fahrenheit. The tests showed an increase of the No. 12 cylinder of an engine operating at 1500 horsepower. Color analysis pictures were taken of the exhaust from increasing amounts of oil of some brand into the exhaust system. The pictures showed that with a small amount of oil, the flow rate was 100 percent because a dirty coating of oil. The flow, however, did not broaden or thicken appreciably. As the flow rate was increased the flow diminished as the coating also thinned because the rich in fuel. As flow rate increased, the smoke appeared in the air of the flow.

[illegible]

The witness stated that the engine breather location is a compromise of several considerations and because of the space re-

gas of dacs enter the No. 5 nozzle into  
the. This is most evident upon examination  
of the exterior of the nozzle.

[illegible]

The expert witness in the field of aircraft fire noted that he would not expect an extensive and worsening flame from the PKY as the result of engine oil being introduced into the assembly. He said that without something for the flame to stick to or adhere to both the flame and flammable material blow away in the aftermath before curbs of a flame could develop. He indicated, however, that in such circumstances holds of flame could be expected. For the same reason he said a sustaining flame could not be expected on a canopy unless in the aftermath even though the engine was being continuously serviced with a fuel supply feed.

### Improbable Possibility

[illegible]

<sup>1</sup>As recorded on March 25, 1999.

being in solid fuel and has an important bearing on this accident. It involved Flight 134, an Eastern Air Lines Constellation, and a model which has identical engine and fuel system to the No. 6 B737. Shortly after takeoff, Flight 134 experienced a failure of the No. 2 engine which, upon examination, showed severe sheared internal damage to the engine which led to the accident under investigation, except the damage, which of the rear row of the power section instead of the front row.

A CAR investigator who witnessed this incident stated that after the engine was shut down and the propeller feathered, he observed a flame which resembled a jet of fire and the exhaust and heater coils and intake warmed at least to the trailing edge of the wing and continued to burn for nearly a minute while the flight made a pattern around the airport. (Miami International) to land.

Examination of the front and rear sections of the well doors revealed heat damage consistent with the exhaust system on the doors. Heat blisters and heat damage resulted on the outside surface of the front and rear motor and driving axles located on the leading axle of the front and rear sections. The front axle of the front section was found on the inside of the rear door in the rear support to the opening between the front and rear doors. The seal between the doors was unchanged. Forensic analysis also disclosed that the mirror outside surface of the front damaged door was treated with enamel and there was an absence of paint on the inside of the front door. Further, oil was dripping from the No. 1 PRT and the hoodline, cut on the same side.

Environments of the engine in this test were not as lethal and there was no loss of weight of cadaver tissue and apparent loss of weight of the engine. It is thus evident that the above results from the type failure studied did not represent against the shell will do so. The procedure of the test was not as severe as the test did enter the cavity between the forest and rear doors with sufficient heat to make deposits on the inside of the rear door as shown in Fig. 4 as a point just after the leading edge.

Analysis of the change and damage per iteration found in the No. 1 engine strongly indicates that the overall condition of the engine is not as good as the No. 10 engine. A comparison of a connecting and analysis the found engine bearing could produce all of the engine damage that occurred; however, it is believed that the engine bearing could have produced this damage in the sequence indicated. Because the No. 10 test showed a slight engine failure while all others showed a severe engine failure, it is believed

Fisher et al. of the No. 10 ad would say *Gastrellia* add encrusting leads on the floor water and, therefore, it must first-filled next. Similarly, roof ore at water ad indicates the remaining potens would begin to ascend permitting the bottom range to pass below the cylinder slabs progressively falling the potens (top, potens and resurgens) into as indicated in diagram figure. Obviously, the unlabeled leads could present falling of the water cell until it failed. During the rising, which was clearly shown as the first water cell, cooking of

the connecting rods and pistons could take place which would reasonably account for the heavy wear patterns found on the top end of one side of the pistons and on the piston skirt on the opposite side.

Initial failure of the connecting rod was due to the damage to the front main bearing shell. All of the failures in the bearing assembly were caused as the piston pin was forced into the bearing housing function. The only parts and pieces which could have caused the bearing wear were those found in the assembly and these were from the front main pistons, connecting rods and rings. In addition to this evidence, part of the bearing found in the oil sumps were found to be the same as the bearing characteristic of a bearing failure. Finally, the bearing failure between the initial occurrence, damage should have been found to the center and rear main bearings as well as to the supporting assemblies of the main shaft; none was found. For these reasons the finding is of the opinion that failure of the bearing assembly, part No. 11E, caused the starting failure.

It may be recalled that the flight crew experienced the engine failure shortly after takeoff and thereafter you conducted what was an unsuccessful fix in the same nacelle. After a careful study of all the available evidence the Board is of the view the two occurrences were related and cannot be so crissed in two isolated events that happened at nearly the same time in the same nacelle. Furthermore, there was no evidence from which could surmise for the fix having been started from a source of ignition within the nacelle.

### Fire Source

It is therefore believed that the fire originated from combustion and events relating to the engine failure. More specifically, rather than the use of manufacturing, there was no physical evidence found to show that the source of ignition came from (a) any of the fuel tanks, (b) the engine, (c) the fuel lines, or (d) from either the nacelle. Thus, it is firmly believed the ignition source for the nacelle fire must have been an external element, which ignited a flammable substance outside of the nacelle. The resulting flame generated the nacelle through the aluminum sheet metal door. Substantive physical evidence, as well as some expert testimony, was available to support this opinion.

During an engine failure of the motor just described, hot liquid ignited engine oil and oil vapors would be forced into the airstream through the exhaust system and from the engine leathers. This raises as to the outcome because two leak points had failed in a manner allowing them to fall into the cockpit where they had burned for some time as evidenced by the fact that

was poured into cells. This condensate would permit condensation of its steam back into the lower exhaust system. Similarly, from each pressure, all and of vapor would be forced from the condenser. In addition, as long as the engine controls are connected at rated power, high inflow and fuel flow would be delivered to all condenser chambers since both can draw steam from one source and operating. Although many of the heat rate points become unusable at compensating the mixture, it was free to join into the exhaust and also to enter the condenser and then into the exhaust.

through the engine breather. This process probably begins during the intake roll, as evidenced by the unusual gray-white smoke observed at this time. It would also continue and increase with the engine intake programs until the retreating action of the engine was stopped, which, according to many respondents, was well after a major fire existed in the nacelle.

Although the tests conducted by Gates Weld indicated that the introduction of air into the exhaust system would not produce an abnormal flame, the M-25 test rig used and visual plot reports prove conclusively that under certain circumstances an abnormal flame will occur. In this instance, leaks inside conditions of engine failure, as abnormal flame occurred and extended outward under the wing to the trailing edge.

Investigation of the accident showed several flame segments on the wing itself, under, inside and outside, in the slot in the main spar between the fuel tank and structural attachment. The fuel tank was empty for a period long after the engine was



## Exhaust Available

It also appears significant that the No. 1 FRT exhaust is angled downward slightly with the opening just overhead, forward, and above the exhaust breather. Also, examination of the oil breather gitters and exhaust train shows they meet at the forward edge of the aft blast door. Thus, after consideration of all the observed conditions, the Board is of the opinion that although gaskets of the breather manifold is not perfect, under certain conditions, it



### Assembly Stand Developed for Turbine Engine

Boeing Airplane Co.'s 120 series lightweight gas turbine engine (AWW July 28, p. 97) is shown in this engine assembly shop, developed by the company's Industrial Products Division. Assembly begins with two turbine inlet housings bolted to the stand. Engine can be turned by a crank which creates a 60-hal. zero moment arm.



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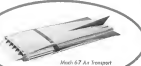
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Because the normal discharge of hydraulic oil enters the nozzle in considerable amounts it is most reasonable to believe a flame from the same source would enter the interior of the nozzle while the wheels were open. Also it is believed that such flame would impinge the floor while they were closed and, if of sufficient intensity, could burn through the aluminum structure in a few seconds. Considerable positive evidence exists linking the flame to believe the latter occurred in this instance.

The specimen is supported by six in-  
laid patterns of unknown metal which  
was expanded outward and inward on the  
central shafted lateral line member.

This could have occurred only in flight by a fire source outside the nacelle which burned through the aluminum doors to supply the nacelle metal. Although several metal splinter patterns found in zone 5 of the nacelle were in accordance with this in-flight event pattern, with the wheel well doors open, it is believed such a pattern would exist with portions of the doors bent inward. Further supporting the opinion that the doors were closed is the fact that five warnings did not occur until after gear retraction when the gear doors would have been closed.

Finally, the photograph of the aircraft during the landing roll showed a major portion of the right front door burned away although the landing gear at that time was well below the area. Again, this because, together with the superheated portions of molten aluminum, heat have been caused by a postulated flame which originated outside the nacelle earlier in the sequence of events.

Thus, by this evidence and the direct action of other free sources, the Board is of the opinion the source of the fire must have been the system of heater discharges which then burned through the wheel well.

### Flame Protection

It is also apparent that the flame postulated zones 1 and 3-4 below the engine are viscous. This is evident by the increase

of sodium metal by the oxygen-driven vacuum pump. It is considered probable that the corrosion of the propeller occurred or was initiated after the vacuum line, which supplied the metal, was melted. With such propeller rotaries a contamination of the supply of flux materials from the vacuum and PRT would exist for a longer period of time.

Even after the fire was extinguished the trees in zone 1 were rotten therefore there could have been no swimming source of flammable in the zone which could have sustained a fire of the magnitude that occurred.

Relatively light damage to zone 5 also indicates that in view of the evidence of lightning there was no way for the fire to enter zone 3 A from zone 5 with the pump up and the fire shield intact, the engine fire must have been ignited in zone 3 A. It is considered most probable, therefore, that the weather flame, after burning through the wheel well door, entered zone 3 A, traveling upward and forward behind the window fire shield to the area of interest.

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Because the outcome became difficult to observe at some 3 A, it is extremely difficult if not impossible, to determine the precise source of the visible material where the combustible for legs or if a pre-existing leak was present in the nose which, upon ignition, caused the flame and the flame to be visible. The large amount of the visible flame. From the fire pattern and apparent airflow it is possible that the location fire supported the previously described kept up at and creating a space of smoke by fire, and/or impinged upon the light chambers also over the No. 1 fuel. After creating a space of fuel. Considering the increased quality of the lines in some of the irregularity of the lines in some of the lines, the procedure for each fire. The stated intent decreased the possibility of an exact leak.

Believing the aging fan was principally at issue, T & A. is immediately apparent because this issue is not covered with the accompanying agent outlets: the fan could not be put out when the crew discharged the foam. This issue is the source of the Bessieville which caused a fire, the effect of the flight engineer's failure to activate the emergency fan will itself cause cannot be determined.

## CONCLUSIONS

On the first run of all the available evidence the Board concluded that in this instance during an engine failure an abnormal clearance had occurred. It is concluded that the flame did, in fact, ignite in a directional discharge of oil and fuel vapour from the outboard No. 5 engine bay area. The resulting flame from the bay area then impinged upon and burned through the right side wall doors and entered the interior of the No. 5 nacelle. The Board concludes that although fire damage occurred in zone 3, the principal loss in the nacelle was due to the loss of a large quantity of fuselage skin and structure. The Board estimates that 1.4 aircraft skin panels were lost. The loss surrounding how the fuselage skin was released cannot be determined.

As a result of the accident the Board has submitted recommendations to the Federal Aviation Agency stating that it is believed necessary in the interest of safety that consideration be given to a requirement that rule 1A of Coastalliance aircraft be used with fire detection and fire extinguishing equipment that that attain a sensitivity which will through directional control of the exhaust flame, ensure that an exhaust exhaust flame will not ignite a booster discharge or rupture upon the wheel well doors when they are fully open or closed.

With respect to the airport rescue and firefighting activities it is the Board's conclusion that a lack of equipment and equipment capabilities was the principal reason the aircraft fire was not extinguished more promptly. The record shows that the Airport Authority, without action to increase its firefighting capability through procurement of new equipment.

### PROBABLE CAUSE

The board determines that the probable cause of the accident was an uncontrollable fire ignited in room 1A by a burning brother's discharge which was caused by an



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## SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of the accident shortly after it occurred. An investigation was commenced in accord with the provisions of Section 708 (a) (1) of the Federal Aeronautics Act of 1958. A public hearing was held at Albany, New York, on May 31 and June 1 and 2, 1959.

Eastern Air Lines, Inc., is a Delaware corporation with corporate offices in New York City. The air carrier is engaged in the transportation of persons, property, and mail by virtue of current certificates of public convenience and necessity and by the Civil Aeronautics Board. It possesses an air carrier operating certificate issued by the Federal Aviation Agency for various routes.

Capt. James W. Bush, age 45, was employed by Eastern Air Lines, Sept. 2, 1942, and became captain in 1944. He held a recently valid airman certificate, with airplane transport rating and multi-engine ratings on DC-3, Aeronca 202-A, DC-67, Lockheed Constellation and L-185. The last test check was Dec. 10, 1958. Capt. Bush held a valid medical certificate, without waivers. At the time of the accident he had a total flying time of 15,304 hr., of which 2,919 was in the Constellation type.

Pilot Robert P. Stricklin, age 35, was employed by Eastern Air Lines, Jan. 31, 1955. He held a valid airman certificate with airplane transport rating and ratings for May 20, 1954-1955. He was checked out as first officer on a Lockheed Constellation model 1049G, equipment Aug. 23, 1955. The last instrument check was satisfactory, accomplished Jan. 7, 1959, and he held a current medical certificate, without waivers. At the time of the accident Pilot Stricklin had a total flying time of 6,880 hr., of which 1,778 were in Constellation equipment.

Flight Engineer Russell R. Etkin, age 35, was employed by the company on Feb. 5, 1955, and became a qualified flight engineer on May 1, 1955. He held a valid airman certificate with flight engineer rating and aircraft and propeller ratings. His aircraft certificate was current. He had completed his last test check Aug. 26, 1958, and his last proficiency check Dec. 10, 1958. Flight Engineer Etkin had a total flying time of 2,217 hr., of which 1,597 were in Constellation equipment.

Flight Attendant Winona Carr, age 23, was employed Nov. 3, 1954, and became a qualified flight attendant by Eastern Air Lines Dec. 5, 1956. Her last scheduled emergency training was Jan. 28, 1959.

Flight Attendant Esther Thayer, age 34, was employed Jan. 8, 1955, and became a qualified flight attendant Feb. 15, 1957. Her last scheduled emergency training was Oct. 1, 1958.

N-674G, a Lockheed 1049G, manufacturer's model number 4605, was acquired by Eastern Air Lines, Inc., Dec. 5, 1955.

At the time of the accident the air craft had accumulated 7,109 flying hours, of which 116 were since the last emergency check on Nov. 24, 1958. The aircraft was powered by Wright engine model 581C18EA5, and Hamilton Standard propeller, model 41605. Made model 4303A. The No. 3 engine had a total time of 3,579 hr. of which 15 hr. were since last overhaul.

## FAA Revises Pilots' Instrument Needs

**Washington—**Commercial pilots now must have a minimum of 10 hr. of instrument flight instruction, under new requirements issued by Federal Aviation Agency, in an amendment to Part 23 of Civil Air Regulations.

Pilots also must demonstrate an ability to accurately control their aircraft solely by the use of instruments and must also demonstrate a cross-country planning ability.

As another amendment, private pilots now will be required to have dual instruction in basic control of aircraft by use of instruments and must demonstrate emergency manual capabilities in attitude control, maintaining the loss of visual reference during flight. Both commercial and private pilots must demonstrate familiarity with route for communications and navigation.

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## WHO'S WHERE

(Continued from page 27)

### Changes

Leslie R. Goble, chief engineer for electronics, American Standard's Military Products Division, Norwood, Mass., succeeding Edward L. Swenson who has been appointed lieutenant colonel to the president of the division.

Mark L. Lebowitz, chief of systems research, Solar Aircraft Co., San Diego, Calif., succeeding C. Ayles Jr., chief of research, Solar's Research and Development Engineering Division.

Dr. William G. Hansen, technical director, General Anastics, Palo Alto, Calif., replacing H. Hughes, general manager, Microwave Division, Raytheon Co. Inc., Van Nuys, Calif., a subsidiary of General Dynamics Equipment Corp.

John E. Hines, head of engineering for CBI Electronics Division of General Electric Corp., Valley Stream, N. Y.

The Vincent Corp.'s Nuclear Systems Division, Van Nuys, Calif., has made the following appointments: Dr. John J. Wagner, staff scientist; Milton M. Westenthal, manager Controls Engineering Department; Alexander N. Reschke, assistant director; the W. L. Vincent Corp.'s Research Laboratories, New York, N. Y.

Thomas F. Capeland, director of flight training, Flight Department, American Airlines, Inc.

Merion J. Koks, director of the newly organized Plans & Program Division of Avco's Avionics, Inc., Goddardsville, Md., Charles E. Martin, director of test, and Herbert A. Richardson, director of production, Texas World Defense Inc., San MacCarty, general management operations, Transconco Air Lines.

Walter deVries, director of the newly organized Advanced Materials Division, Raytheon Co., Norcross, Ga.

Philip H. Young, assistant chief engineer, Space Recovery Systems, Inc., El Segundo, Calif.

Dr. Virgil L. Swan, director of solid projectile operations, Oerlikon plant of Olin Matheson Chemical Corp., Merion, Ill., Leslie G. Carter, operations manager, New York Avionics, Inc.; Capt. Frank Le-Tasson, assistant chief, Cater is chief pilot; Maj. Capt. Edwin N. Ross, assistant chief pilot.

Benjamin F. Rose, Jr., manager of the newly formed Avionics Division, General Electric, at North General, G. Co., Chicago, Ill.

George J. Vito, Washington D. C. manager NAVA's for Casualty Division of General Dynamics Corp.; Thomas G. Arnold, assistant chief, Air Vets in Washington representative for Calsonic (Vetronics).

James S. Fennel, Polaris missile systems guidance manager, Lockheed Missiles and Space Division, Sunnyvale, Calif., succeeding A. F. Hughes who succeeds Polaris internal systems manager.

S. Austin Van Buren, manager of production and external control, Hughes Aircraft Co.'s Ground Systems Group, Fullerton, Calif.; Vito John C. Moore, manager of quality assurance for the Ground Systems Group.

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"Application of Computer Simulation in Production System Design," a paper by Allen F. Rowe, is available upon request. Send request to Dr. Rowe in SDC.



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## Linguistic Incongruity

In reply to Mr. Holland's letter "Word Choice," in the Oct. 26 issue p. 114: I believe it is foolish to call a Russian 60 Hz a small wave his questioning your choice of words.

In a definition GMR 60 Hz states "New Wave Flight Instruments (intentionally) provided in an aircraft cockpit as a simple device as an aid to an electronic attitude, or an electronic indication."

Very few pilots I know use the term new wave in their discussion on flying. It seems to me the introduction of a word here is just another example of the antiquation of the English language. Yours?

Ed Fox, James H. Bresser  
USFV  
Woolfield, England

## Defense Dollars

"Washington, June 6—The Navy is spending \$1.5 billion for supplies built by the Martin Co. under a \$440,000,000 contract awarded last August.

A Navy spokesman said public and private contracts will be awarded before the bids are opened.

"The program was stopped in August in an effort to save \$72 million in proposed expenditures for this phase and equipment."

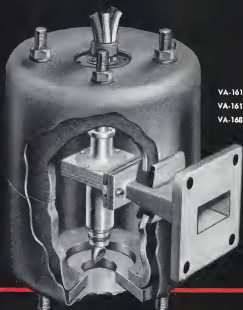
The other news release appeared in the Oakland Tribune, Nov. 1, 1959. The public, who are not concerned with the billions of dollars that are paid to the defense of this country. Let us look at the small cost of the Navy Department in matters of procurement. Continue the program under the completion of law to pay for these common expenditures is related to something that is in the way of defense of this homeland. Let us look at the small cost of the navy.

(1) The Navy, jet engine plant at Fort Worth, Texas, cost \$150 million.

(2) The McDonnell F4B-1, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 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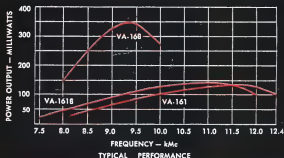


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